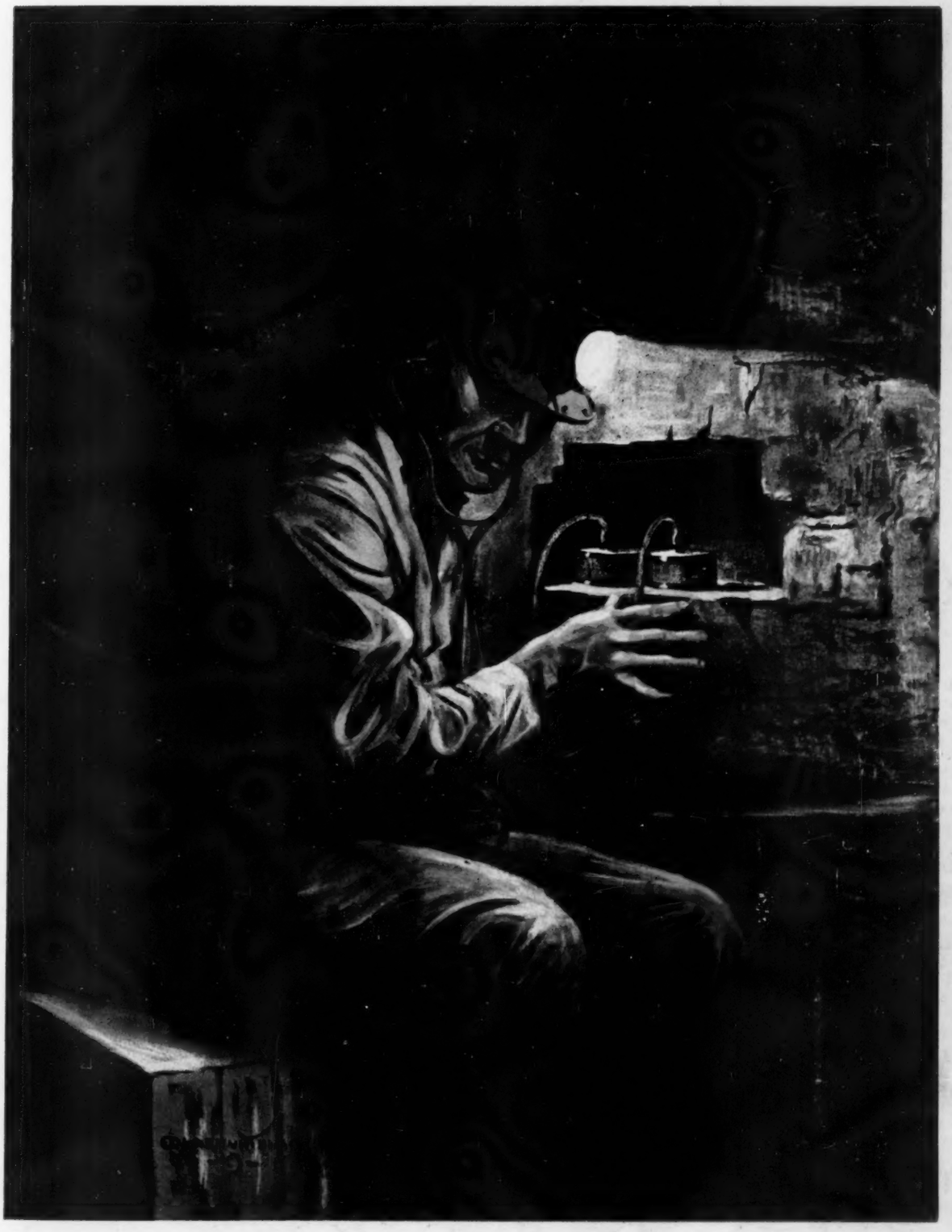
SCIENTIFIC AMERICAN

Entered as second class matter June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879.

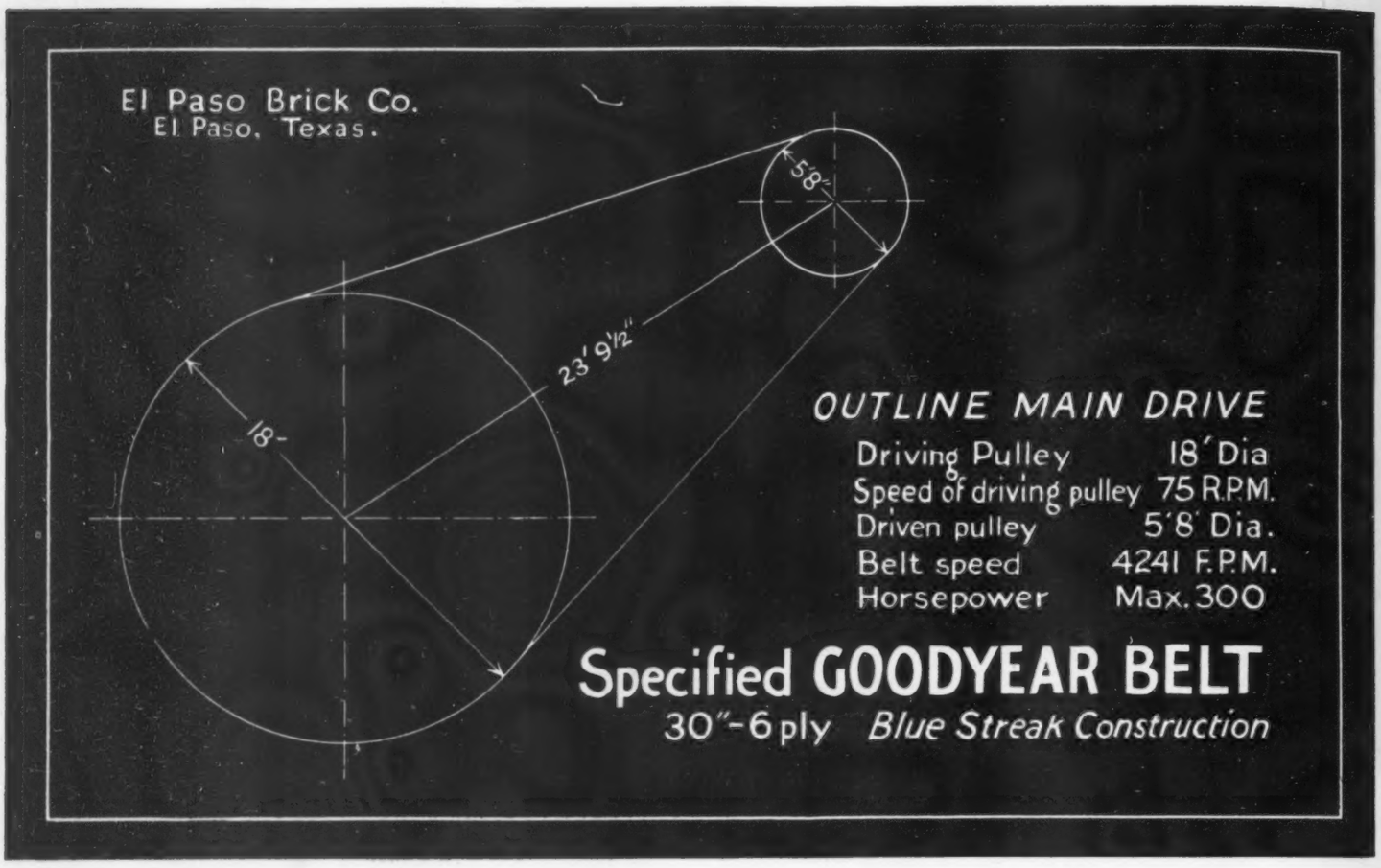


LOCATING ENTOMBED MINERS BY AID OF THE GEOPHONE [See page 581]

Vol. CXX. No. 22
May 31, 1919

Published Weekly by
Scientific American Publishing Co.
Munn & Co., New York, N. Y.

Price 10 Cents
$5.00 a Year



Wasted Horsepower—and the G. T. M.

It was a spendthrift of power and a trouble maker of the first class, that main-drive in the El Paso Brick Company's plant. Some years ago it was all right, but as the company grew it got worse and worse. Every kind and many grades of belt were tried on it. They slipped and jumped and stretched. They wasted horsepower-hours by the hundred. Most of them lasted only four or six months. The most expensive ran their unreliable way for about a year. They made that main-drive one of the most costly things in the plant. Finally the manager, Mr. Rodgers, asked a G. T. M.—Goodyear Technical Man—to call.

The G. T. M.—our Mr. Watson—was told by Mr. Rodgers that it was planned to try out an 18-inch 8-ply Goodyear Belt of Blue Streak construction, but that it would be a good thing to look over the drive first. The G. T. M. thought it would be a good thing to *study* the drive—so they went and looked and measured.

There was 300 horsepower coming off a fly wheel with a 40-inch face and intended for delivery to a shaft-pulley *with an 18-inch face.* But 105 of the 300 were being wasted by slippage, because that line-shaft pulley-face hadn't grown with the plant. When the plant was young it had been all right, but as production and loads increased, it became much too small.

The G. T. M. recommended to Mr. Rodgers that he put on a line-shaft pulley with a face to take a 30-inch belt, specified a 30-inch 6-ply Blue Streak, stated his reasons, and was told to go ahead. He did. When the belt came, the G. T. M. went and bought the proper fasteners himself, just to make sure that they would be the right size. The belt and the new pulley were installed in April, 1918, and that main-drive has been a joy ever since.

From the first more than 100 of the 105 horsepower formerly wasted has been saved. The belt runs with perfect smoothness and evenness even under the heaviest overloads. It hasn't needed attention once. And it costs much less than those that used to slip, stretch and break under overload, and waste a thousand horse-power hours in an ordinary working day. And the Goodyear Belt specified by the G. T. M. is in Mr. Rodgers' judgment good for several more years.

There are many main-drives for which a G. T. M. can do similar things—main-drives still belted according to precedent instead of in accordance with the real conditions. Not all of them have outgrown pulley-faces, but many have; and scores of others are using belts of the wrong construction, others have belts made of materials that require such extraordinary tightening that they are hard on bearings, cause shafting to weave, and waste power and time in many other ways.

Ask a G. T. M. to look over your main-drive. He will call when next he is in your vicinity. He may find it all right—and if it is, he will tell you so. If it isn't, and he recommends certain changes, you are in no way obligated to carry them out unless his reasons convince you. And bear in mind that the main-drive is the most neglected, taken-for-granted, precedent-burdened drive in three plants out of every four.

THE GOODYEAR TIRE & RUBBER COMPANY, AKRON, OHIO

BELTING · PACKING · HOSE · VALVES

GOODYEAR

AKRON

Vanguard of fleet of 38 Liberty Trucks passing through Oakville, Delaware County, Ind., in August, 1918, over Tarvia Road built in 1916. Note perfect condition of road after two years of hard service.

Every community should have roads like these—

HERE is the story of how Delaware County, Indiana, got good roads, as told by the County Surveyor. Everyone interested in good roads should read it.

"Our first Tarvia road was built in 1914. Between 1914 and 1918 we constructed sixteen streets and roads, with a total area of about 2,880,000 square feet.

"Some of these are main streets in the city of Muncie, others are main roads subject to heavy traffic, while others replaced low-lying gravel roads that used to wash out at every overflow of the river.

"Every Tarvia road and street in Delaware County has given uniform satisfaction. No repairs have been necessary.

"Our so-called 'hard' roads, built of brick or concrete, are often claimed as permanent construction, but we have in this county brick roads and streets built less than a decade ago that are almost impassable and must soon be rebuilt. New material will be required because the old brick cannot be used again.

"On the other hand, when a Tarvia road wears, a little stone is added, Tarvia is applied, and the road is as good as, or better than, new.

"With proper maintenance, our Tarvia roads will last ten to twenty years. The cost of maintenance will be small and the entire road can be rebuilt at less than half the cost of a brick pavement.

"Considering the various types of road from a purely financial standpoint, one does not need to be skilled in higher mathematics to arrive at the correct answer."

(Signed) S. Horace Weber, County Surveyor.

Tarvia is a coal-tar preparation for use in constructing new macadam roads or repairing old ones. It reinforces the road surface and makes it not only mudless and dustless, but also water-proof, frost-proof and automobile-proof. A few Tarvia Roads in any community will add to property values and reduce taxes.

Illustrated Tarvia Booklet free on request.

Special Service Department

In order to bring the facts before tax payers as well as road authorities, The Barrett Company has organized a Special Service Department, which keeps up to the minute on all road problems.

If you will write to the nearest office regarding road conditions or problems in your vicinity the matter will have the prompt attention of experienced engineers.

This service is free for the asking.

If you want *better roads* and *lower taxes*, this Department can greatly assist you.

Tarvia

Preserves Roads—Prevents Dust

New York, Cleveland, Birmingham, Seattle, Youngstown, Chicago, Cincinnati, Kansas City, Peoria, Toledo, Philadelphia, Pittsburgh, Minneapolis, Atlanta, Columbus, Duluth, Richmond, Winnipeg, Milwaukee, Latrobe, Dallas, Bangor, Bethlehem, Boston, Detroit, Nashville, Washington, Elizabeth, St. Louis, New Orleans, Salt Lake City, Johnstown, Buffalo, Baltimore, Lebanon

The Barrett Company

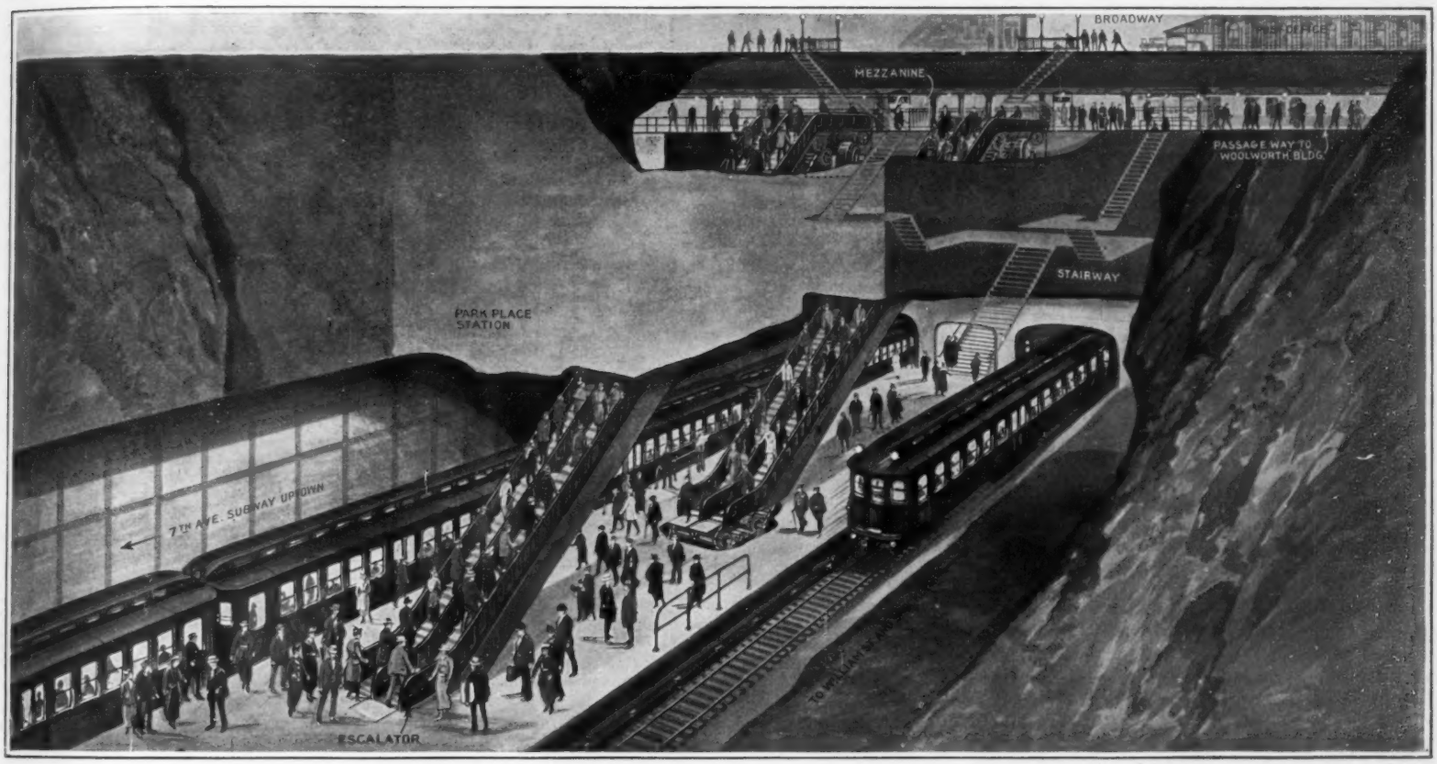
THE BARRETT COMPANY, Limited: Montreal, Toronto, Vancouver, St. John, N.B., Halifax, N.S., Sydney, N.S.

SEVENTY-FIFTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXX.] NUMBER 22] NEW YORK, MAY 31, 1919 [10 CENTS A COPY $5.00 A YEAR



The deep subway station at Park Place, New York, showing the escalator system as it will appear when completed

The Park Place Subway Station Escalators

THE Seventh Avenue subway coming down the west side of the New York city turns east at Park Place, passing under the Post Office and on to William, where it turns downtown again and eventually runs under the East River to Brooklyn. In its course across town, it must run under two existing subways, namely, the Brooklyn Rapid Transit Subway which runs under Broadway at this point and the old Interborough Subway which passes under Park Row. This makes it necessary for the subway at Park Place to descend to a very low level, and as a consequence passengers who use the Park Place station have a long climb from the station platform to the street. The actual vertical distance is 38½ feet. In other words it is a three-story climb, a breathless undertaking for many persons.

When the station was planned, provision was made for a pair of escalators to carry passengers to and from the station platform. The wells for these escalators were made wide enough to use the largest type of double-width escalator which would accommodate three persons abreast on each step. It was thought advisable, however, to use narrower escalators than these, so that four of them could be installed. The purpose of this was to provide greater flexibility of operation; for each could be driven separately and a design was chosen which would permit of reversing the escalators so that, if desirable, the majority of them could be operated to carry passengers upward in the morning rush hours and downward in the evening rush hours or likewise adapted to handling crowds on special occasions.

There are two well-known types of escalator in common use, one known as the step type and the other the cleat type. In the step type, the steps are arranged to run out on the same plane at the top and bottom of the escalator so as to form platforms for exit from and entrance to the escalator. The passengers step upon these platforms from the side and in leaving the escalator there is a diagonal shunt which would naturally guide a passenger to the side of the platform. With this type of escalator it is not advisable to have the passenger step off the end of the moving platform, owing to the danger of tripping.

Where the cleat type of escalator is installed, entrance to and exit from the escalator is made directly at the ends. The traveling cleats which form the steps of the escalator run between a comb plate which lifts the passenger's feet off the moving cleats, if for any reason he should not step off the escalator at the exit point. Owing to the comparatively narrow platforms of the Park Place station, it was considered inadvisable to have the ordinary step escalator with side shunt at the exit point, and so a compromise was effected in the design of an escalator which is of the step type and yet combines the cleat form of exit and entrance. This is something decidedly new in escalators. One of these escalators is now being installed at the Park Place subway, and its operation will be watched with great interest. If the escalator proves successful, and there is every reason to believe that it will, other escalators of the same type will be installed. The steps are 18 inches wide and 16 inches deep, with 8-inch risers. The surface of the step is formed with deep cleats running parallel to the direction of the escalator and, as in the ordinary escalator, the steps run out on a common plane at the top and bottom to form the entrance and exit platforms, and at these points there are comb plates with the teeth of the combs projecting between the cleats of the steps, so that they will automatically lift the passenger's feet off the step upon the fixed platform.

The escalator which is now being installed and may be in service by the time this article is published, has a capacity of 3,600 passengers per hour, and it rises at an angle of 30 degrees, running at the rate of 90 feet per minute. Long experience has proved that a higher rate than this is apt to cause injury to careless passengers. While the steps are only 18 inches wide, the space between handrails is 24 inches wide, so that there is ample room for a single passenger, but not more than one person can occupy a step at a single time. Each step is really a platform on which a passenger can stand, and this is the reason that it is so much deeper than the ordinary fixed stairway step. A 22-horse power electric motor is used to operate the escalator, which it does through a worm gear. An electric brake is automatically put in service when the motor stops running and is released by the turning on of the motor. The escalator rises 28 feet from the station platform to the mezzanine floor.

At present, traffic conditions at the Park Place subway station are such that a single escalator will more than accommodate all the passengers travelling in a single direction. Two escalators will be ample for all the traffic for many years to come, but looking into the future, provision has been made for four escalators, and our artist in the accompanying engraving has given us a picture of the appearance of this station when the complete equipment is installed. The fixed stairways, which provide the only means of ingress and egress at present, are shown in phantom in the engraving.

SCIENTIFIC AMERICAN

Published by Scientific American Publishing Co.
Founded 1845

New York, Saturday, May 31, 1919

Munn & Co., 233 Broadway, New York

Charles Allen Munn, President; Orson D. Munn, Treasurer
Allan C. Hoffman, Secretary; all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

To the Mayor of New York

IF the mayor of this city should have, or make, occasion to walk across the Brooklyn Bridge by way of the promenade, he would see for himself unmistakable evidence that this great structure is suffering from a neglect which shortens its life and, if it extends to the whole bridge, may well be threatening its safety. We refer to the pins in the top chords of the stiffening trusses adjoining the promenade, where any passerby may identify several worn pins by the broad streaks of rust which surround them and discolor the steel-work below. So great has been the corrosion, that some of the joints show a wear of as much as an eighth of an inch. This is proved by the fact that under the load of a passing train, the nuts which hold the pins in place have a lateral movement of that amount, returning to their normal position when the train has passed. When it is remembered that the assembly of chord, eyebars, and post at a panel point is supposed to receive the pin with a tight fit, it does not take a bridge engineer to understand that the structure, at least in this particular part of it, has been subjected to a shocking neglect.

A great engineering work such as this, if it be carefully and periodically inspected, should be as enduring as the Pyramids; but if it be neglected, its deterioration will be progressive at an ever-multiplying rate. Hence the question naturally arises as to whether the evidence of neglect which any passer-by may see for himself, extends to those parts of the structure which are remote and require special facility and the trained eye of an expert for their proper inspection. Indeed the city authorities have only themselves to thank if the citizens of New York and Brooklyn assume that the whole bridge, from anchorage to anchorage, is in a similar condition of neglect and disrepair.

The SCIENTIFIC AMERICAN has felt a particular interest in the question the care of this structure since the day, in July, 1901, when similar neglect came very near to causing the whole floor of the bridge to break away from the suspenders and main cables, and drop into the East River. The matter was discussed in our issue of August 3d, 1901. The salient facts of this near-disaster were as follows:

At the center of the bridge, to allow for the lateral movement of the trusses, under the action of the passing trains, and also of temperature changes, the suspenders by which the trusses and floor are hung from the main cables, are provided with rocker bearings where their lower ends connect with the trusses. Due to neglect these bearings became badly rusted. The pins moved with great resistance, if at all, and the reverse bending stresses thereby thrown on the suspenders, which, at the center of the bridge were solid rods, ultimately caused them to break in two, leaving the floor at that point without their support. It sagged heavily, being now held up merely by the cantilever action of the floor beams, which, fortunately, are continuous from side to side of the bridge. The heavy bending stresses thus thrown upon the floor beams were entirely additional to the load for which they were designed, and, that they should have saved the situation, is a tribute at once to the excellence of the material and the forbearance of a kindly Providence.

Luckily, the sag of the roadway happened to be noticed by a bridge policeman. We say "luckily," for had a few closely-bunched trolley cars (there was no spacing of cars in those days) with a heavy dray or two, to say nothing of an elevated train, passed simultaneously on to that part of the roadway, the whole floor of the bridge would have commenced to rip away from the suspenders with accumulative action.

And what is the condition of those rocker joints today? We presume they are regularly inspected; but the millions of citizens who make use of this structure would like to feel assured that the neglect which is visible on the promenade does not extend to the bridge as a whole.

We have no wish to play the alarmist. The Brooklyn Bridge is perfectly well able to carry its present load provided, always provided, that the city officials are giving it the close inspection which every great bridge should have. Particularly is it true of a mammoth structure such as this that eternal vigilance is the price of safety.

Boy Scout Week

HOW many of us have adequately visualized the increment which was added to our great national effort of the past two years through the efforts of the Boy Scouts? Of course, we all are acquainted with the existence, and more or less with the aims, of this admirable organization; but are we not inclined to pass over its performance without a due meed of credit or acknowledgement?

When the Nation called, the Boy Scouts, then 300,000 strong, responded because they were prepared In the first four Liberty Loan campaigns, acting for the most part as gleaners after the reapers, they sold 1,967,047 bonds, amounting to $276,744,650. They placed War Savings Stamps in excess of $50,000,000. They located 5,200 carloads of standing walnut, and collected over 100 carloads of fruit and nut pits. They distributed over 50,000,000 pieces of Government literature. They conducted war gardens and war farms throughout the country. They rendered all sorts of invaluable services to the Red Cross, the United War Work Committee, the American Library Association, and various other organizations that were serving the Government. They performed countless individual acts of service to the Government which are not recordable under any particular classification. They presented a united front of patriotic zeal in every community, which in itself was of incalculable value to the nation.

Not alone to the boys who did these things is credit due. To the hundred thousand men who have acted as scoutmasters, committeemen, council members and officials—only 250 of whom are paid, the rest being volunteers—credit is due also, and the recognition of their efforts which is involved in recognition of the Boy Scouts as a real force in the community, the state and the nation. It is for this reason that a National Citizens' Committee, under the Chairmanship of ex-Secretary McAdoo, has been formed for the purpose of expressing the nation's appreciation of what the Boy Scouts of America did during the war. This expression will take the form of a nation-wide Boy Scout Week, from June 8th to 14th. It will aim, among other things, to focus the attention of the public on what the Boy Scout movement really stands for, the immense part it played in the war, and what it is expected to do in the future.

Externally, perhaps, the prominent feature will be the effort to get into the Boy Scouts every boy who will benefit by the associations which they offer him and the ideals they hold out for him—which means every boy in America. But for the thoughtful citizen the Boy Scout will mean far more than this. It will mean closer contact with the agencies which have taken the vast reservoir of boy power, so often turned to mischievous ends, and diverted it into channels where it is of tremendous benefit alike to the boy and to the rest of us. This is what the Boy Scouts stand for.

Further Light on the Shipping Situation

IN our issue of May 17th, 1919, we referred to the views of an experienced shipowner and operator, Mr. Robert Dollar, on the shipping situation, and subsequently our attention has been directed by Mr. Hurley, Chairman of the Shipping Board, to a review of the subject by another well-known expert, Mr. J. H. Rosseter, director of the Division of Operations of the Shipping Board. Inasmuch as this is based upon 30 years of practical experience, we take pleasure in laying a digest of Mr. Rosseter's statement before our readers.

We are reminded in the first place that the amount of wages paid is to be properly measured by accomplishment, and this authority believes it would be a mistake to reduce either the wages, quality of food, or the number of officers and men employed on American ships, since his experience has proved that the more efficient service rendered is well worth the higher pay and better treatment. He admits that we are subject to unnecessary cost as the result of stupid and needless regulations in the form of tonnage measurements, a matter which should be immediately adjusted.

The above, however, are not the really important issues. Upon the Great Lakes we have, ready to hand, an example of the possible low cost of water-borne commerce. Here we find that American-built and American-manned ships are handling and carrying cargo at the lowest cost per ton in the world's commerce. If, under the spur of necessity, we have accomplished this result on the Great Lakes, we surely, by similar methods applied in a broad-minded way, may expect to achieve commensurate results in deep-sea traffic. Mr. Rosseter states that the higher cost of manning has been exaggerated, since in his experience it amounts to less than 2 per cent of the total operating expenses. This is far below Mr. Robert Dollar's estimate, but Mr. Rosseter believes that in any case, the higher cost can be more than offset by increasing the speed of our ships and bringing our equipment for loading and discharging up to date.

Another advantage over our competitors which is fundamental and permanent, is the vast supply of oil fuel which is available for our merchant marine. He states that with the ordinary reciprocating engines one-third greater distance can be steamed with a ton of oil than with a ton of coal, and the great majority of our competitors are using, and for a long time to come will use, coal. Not only is greater distance made, but it is done with a very considerable reduction in the boiler-room force. The numerous "black squad" will give way to a few men who will exchange the shovel for the valves of the oil burners. Other questions which must be faced and for which an adequate solution must be found if our new merchant fleets are to enter into successful world competition, are, first, improved types of ships and reduced costs due to American methods of labor saving, in which we should be able ultimately to lead the world. Secondly, the coördination of our railway and steamship lines—an absolutely necessary reform if we are to reduce the total cost of transportation from inland manufacturer to foreign consumer. Third, the development of efficient maritime organizations, not only at home, but in all the foreign ports of the world; for here is one of the foundation stones without which no successful foreign commerce can be built up. Fourth, shipowners and merchants must be assured of the lowest possible rates of marine insurance, at least in the earliest days of this great venture. Fifth, it is also necessary that favorable facilities be provided for foreign exchange and discounts. Lastly, and we commend this feature particularly to the careful consideration and speedy action of Congress, such conservation measures should be authorized as will assure for our great merchant fleet an adequate supply of oil fuel.

Before the war, as we have frequently pointed out in our advocacy of a larger merchant marine, it was estimated that some three hundred million dollars per year was lost to the country because of its almost complete reliance upon foreign ships for carrying its foreign trade. In the immediate future, because of the universal increase of trade and of our ability to carry not only our own exports and imports, but a fair share of the world's commerce, we believe that Mr. Rosseter's estimate of an increased revenue of over five hundred million dollars per year is not excessive.

Very apt in its application to the present era of checquered history of United States shipping is that great maritime metaphor of Shakespeare: "There is a tide in the affairs of men, which, taken at the flood, leads on to fortune." The United States stands face to face with a great opportunity, never before presented and never, in all probability, to come our way again. There is a call for farseeing legislation by Congress.

Engineering

The Lumber Production in 1918, according to tables recently published by the U. S. Forest Service, show a total of 32,760,000,000 feet. The production for 1917 was 36,000,000,000 feet, so that the past year shows a considerable decrease in lumber production; this was most marked in the southern and eastern states.

The Docks at Falmouth.—In a recent issue of the SCIENTIFIC AMERICAN we described the new docks at Falmouth. The final plans show that provision will here be made for 40,000 feet of deep-water wharves with a depth of 44 feet alongside at low water, and there will be an 1,100-foot dry dock. At first, only about one-sixth of the docks will be built, but it is possible that the British Government will show sufficient interest in these docks to have the entire 40,000 feet constructed immediately. The Government looks upon Falmouth as one of the finest sites for a terminal port and port of call in the United Kingdom.

Moving a 300-Ton Gas Container.—A recent issue of the *Engineering News Record* described a novel moving job at Portland, Ore. A gas container 70 feet in diameter and 75 feet high, weighing 300 tons, was moved a distance of three miles. First, it was raised 15 feet and loaded on rollers. Then it was moved four blocks through the city streets and lowered 28 feet to a dock, whence it was moved upon a pair of barges. The barges were towed three miles to a shipbuilding plant, where the tank was unloaded and raised 26 feet, moved across newly-filled ground for a distance of 2,000 feet, crossing a railroad track and placed on its new foundation. It took 71 days to complete the work.

Reinforcing Bridge Piles with Concrete.—A novel example of concrete work is to be found in the reconstruction of the pile foundation of a long wooden highway trestle at Port Angeles, Washington. The bridge is 2,000 feet long and crosses the bay at this point. On examination it was found that the piles had been badly eaten away by teredoes. As it was important to maintain the highway traffic without interruption, the piles were not renewed, but were reinforced by a concrete covering. Forms two feet square, inside measurement, were placed around the piles and filled with concrete. This was done during the eight-hour period of lowest tide and it was necessary to wedge the forms down to keep them from being floated as the water rose. The forms were made in six-foot lengths and if necessary were extended after the first length had been filled with concrete.

Raising a Railroad Bridge Without Interrupting Traffic.—Last year the War Department ordered the raising of the Pittsburg, Fort Wayne and Chicago railroad bridge over the Allegheny to increase the clearance by 12½ feet and required that the work be done within a year's time. The operation was performed by introducing jacks under the spans and raising the bridge gradually. The jacks were operated only when there were no trains passing and the work had to be done little by little on a single pier at a time, the operations being carried on consecutively from pier to pier, so as to avoid sharp grades. The bridge is a four-track, two-level structure and the truss spans were raised simultaneously by means of hydraulic jacks. The work was recently brought to a successful conclusion within the time specified by the Government.

Dustless Macadam Roads.—The roads at the River Rouge Naval Training Camp, Detroit, Mich., have been treated with a surfacing material of deliquescent salts which have made them dustless and also noiseless. The great difficulty with water-bound macadam roads heretofore has been to keep them at the proper degree of moisture. They were apt to be too dry, which would result in wearing away the road surface and its dissipation in the form of dust. This caused the road material to break up rapidly. If the road were kept too wet, it was inclined to become soft and would be crushed too readily by heavy loads. But in the roads at Detroit just referred to, the use of materials such as calcium, magnesium, and other chlorides from the salt wells, kept the surface at the proper degree of moisture by gathering the moisture from the air and from the soil below the road bed and retaining moisture from rains. This has been found to be effective check on dust production. A cubic yard of the material was found to cover seven square yards of road at cost of $1.25 per square yard.

Science

"Oak Leaf Poisoning of Domestic Animals" is the title of a new bulletin of the U. S. Department of Agriculture. Investigations made by the Department show that while an exclusive diet of oak leaves produces illness in cattle, and often proves fatal, these leaves are harmless if combined with other kinds of food. As small a quantity of alfalfa hay as three pounds daily, fed in connection with oak leaves, prevents poisoning. On the western cattle ranges the cases of oak-leaf poisoning occur mostly in spring, because at that season there is a scarcity of other forage.

Paradise Key.—Mr. W. E. Safford, in a lecture before the Botanical Society of Washington, recently called attention to the great botanical interest attaching to Paradise Key, an island in the heart of the Florida Everglades, some 90 miles south of Lake Okechobee. This island is unique as an example, within the United States, of a subtropical jungle unspoiled by man. Though the temperature sometimes falls below the freezing point, many tropical plants abound, including lofty royal palms, which have given the name of Royal Palm State Park to a tract of land in which Paradise Key is included. A memoir by Mr. Safford on the physical geography and botany of this region is to be published by the Smithsonian Institution.

Testing of Clinical Thermometers in Europe.—It is reported in *Nature* that since the Clinical Thermometer Order of last October was issued by the British authorities half a million clinical thermometers have been tested at the National Physical Laboratory, where more of these instruments are now tested in a week than were formerly tested in a year. It is found that about four per cent of the thermometers fail to comply with the provisions of the order. For one firm of makers, having a large output, the number of rejected instruments has exceeded 25 per cent, while in the stocks of instruments that have been sent in by dealers the rejections amount to from nine to ten per cent. The French government has recently followed the example of the British and issued an order making compulsory the testing of clinical thermometers sold in France and restricting the types of instruments that may be offered for sale.

The Earliest Plan of New York.—Dr. F. C. Wieder, of the Royal Netherlands Geographical Society, who has recently carried out extensive investigations concerning early explorations of the region about the present site of New York city, has brought to light an earlier plan of New York than any previously known. According to an account of this discovery published in the *Geographical Journal*, the map appears to have been based on a survey made in 1660, and shows a regular series of intercrossing streets, proving that even at that period, though few houses had been erected, the whole plan of the city had been laid out, even to the modern "townships." This map, which was found at the Villa Castello in Florence, is the only one thus far known dating from the period of Dutch sovereignty on Manhattan Island. The so-called "Duke's plan," preserved in the British Museum, formerly the earliest one known, appears to be, in fact, only an inferior British copy of the Dutch map.

Ships' Ballast as a Source of Plant Enemies.—In view of the well-known danger of the introduction of insect pests into this country in the earth around imported plants, it has been suggested that such pests may also be imported in the earth used as ballast in ships returning from Europe. Careful investigations of this suggested danger have been made during the last few months by the Federal Horticultural Board. War conditions greatly increased the amount of ballast brought to our eastern ports, as transports carrying troops abroad mostly returned in ballast. It appears, however, that most ballast consists of sand, gravel broken rock, and sometimes ashes. Soil, when employed, is generally derived from river banks or from excavations for construction purposes, rather than from cultivated land, and is therefore not likely to prove dangerous to plants. The sand and gravel thus arriving from abroad is usually sold for building or other construction purposes, while the broken rock and soil have been used for fills near the waterfront or towed to sea and dumped along with city waste. On the whole, there seems to be no serious danger from this source.

Aeronautical

Brazil's Aviation Service.—The Vice President, ad interim, has officially authorized, by decree No. 13417, of January 15th, 1919, the opening of a special credit to the Ministry of War for an amount of 2,000 contos of reis (about $500,000 in American currency), to be used in organizing an aviation service, buying airplanes, establishing aviation schools, and purchasing various accessories.

Radio Telephony for Range Finding.—The experiment of adjustment of fire by radio telephony was recently conducted with gratifying success at the School of Fire at Fort Sill, Okla. Qualified observers though without previous radio telephone training, conducted shoots using radio telephony instead of radio telegraphy with gun crews also untrained in this new method. The radio telegraphic equipment now available for a observation work is slow to operate, even with operators sending and receiving. The radio tele on the other hand, gives an unbroken communi both ways direct with the battery. The advanta this direct communication are: Elimination o probability of error, saving the time of relaying message, and making it possible for the observer to down corrections rather than observations. In fact, trained artillery officer can easily conduct the fire of t or even three, batteries with speed and accuracy.

Abandoned Aviation Fields.—The War Depa ment has decided to abandon the following flying field Barron Field, Ft. Worth, Texas; Call Field, Wichita Falls, Texas; Carruthers Field, Ft. Worth, Texas; Eberts Field, Lonoke, Arkansas; Love Field, Dallas, Texas; Payne Field, West Point, Miss.; Rich Field, Waco, Texas; Taliaferro Field, Ft. Worth, Texas; Taylor Field, Montgomery, Ala.; and Gerstner Field, Lake Charles, La., as soon as equipment now in storage at these fields can be disposed of. The abandonment of Gerstner Field will be completed by June 30th next. It is intended to sell or salvage the buildings and improvements unless they can be utilized to advantage by some other department of the Government. The War Department has requested information from these other departments as to whether they desire to make use of any of these fields, and, if so, that further details will be supplied by the Construction Demobilization Committee of the General Staff.

Fatalities with the Christmas Strutless Biplane.—With the death of Aviator Jolly a few weeks ago, the Christmas "Bullet" has two victims as its record to date. The day following the accident which resulted in the death of Jolly, the writer of these notes happened to be eating in the Post of one of the flying fields on Long Island, where the unfortunate airman was well known and liked. Feeling was running rather high among the airmen and mechanics, who criticized the design of the Christmas cantilever plane which differs so radically from accepted practices. They pointed to the previous collapse of the "Bullet," which killed another airman. Jolly, so it seems, met with the same kind of fate; in mid-air one of the wings broke off and he was hurled to earth. These same airmen and mechanics criticized periodicals which accepted advertising for machines which are of questionable safety. They were agreed, according to the conversation, that this is a rather late day to experiment with uncertain designs.

Civilian Aviation.—Before operating civilian aircraft, including airplanes, seaplanes and balloons, all persons must secure a license to do so from the Joint Army and Navy Board of Aeronautic Cognizance, Building D, Sixth and B Streets, Washington, D. C., according to the Presidential Proclamation of February 28th, 1918. During the parade of the 27th Division in New York City, a flying boat, piloted by an unlicensed civilian, flew up and down Fifth Avenue above the parade at a dangerously low altitude, estimated as between three and five hundred feet. In case of engine failure, the pilot could not have reached a landing place, but would have been forced to land in the crowd on the avenue. The Board cautions airplane operators against a repetition of such an occurrence, and warns that licenses must be secured by civilian fliers. The Army and Navy Board has control of all aircraft licenses for civilians, and points out that there is no way of adequately providing for public safety when airplanes fly at low altitudes over cities or large assemblies. Applications for licenses should be sent to Secretary, at the above address.

SCIENTIFIC AMERICAN

Published by Scientific American Publishing Co.
Founded 1845

New York, Saturday, May 31, 1919

Munn & Co., 233 Broadway, New York

Charles Allen Munn, President; Orson D. Munn, Treasurer
Allan C. Hoffman, Secretary; all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

To the Mayor of New York

IF the mayor of this city should have, or make, occasion to walk across the Brooklyn Bridge by way of the promenade, he would see for himself unmistakable evidence that this great structure is suffering from a neglect which shortens its life and, if it extends to the whole bridge, may well be threatening its safety. We refer to the pins in the top chords of the stiffening trusses adjoining the promenade, where any passerby may identify several worn pins by the broad streaks of rust which surround them and discolor the steel-work below. So great has been the corrosion, that some of the joints show a wear of as much as an eighth of an inch. This is proved by the fact that under the load of a passing train, the nuts which hold the pins in place have a lateral movement of that amount, returning to their normal position when the train has passed. When it is remembered that the assembly of chord, eyebars, and post at a panel point is supposed to receive the pin with a tight fit, it does not take a bridge engineer to understand that the structure, at least in this particular part of it, has been subjected to a shocking neglect.

A great engineering work such as this, if it be carefully and periodically inspected, should be as enduring as the Pyramids; but if it be neglected, its deterioration will be progressive at an ever-multiplying rate. Hence the question naturally arises as to whether the evidence of neglect which any passer-by may see for himself, extends to those parts of the structure which are remote and require special facility and the trained eye of an expert for their proper inspection. Indeed the city authorities have only themselves to thank if the citizens of New York and Brooklyn assume that the whole bridge, from anchorage to anchorage, is in a similar condition of neglect and disrepair.

The SCIENTIFIC AMERICAN has felt a particular interest in the question the care of this structure since the day, in July, 1901, when similar neglect came very near to causing the whole floor of the bridge to break away from the suspenders and main cables, and drop into the East River. The matter was discussed in our issue of August 3d, 1901. The salient facts of this near-disaster were as follows:

At the center of the bridge, to allow for the lateral movement of the trusses, under the action of the passing trains, and also of temperature changes, the suspenders by which the trusses and floor are hung from the main cables, are provided with rocker bearings where their lower ends connect with the trusses. Due to neglect these bearings became badly rusted. The pins moved with great resistance, if at all, and the reverse bending stresses thereby thrown on the suspenders, which, at the center of the bridge were solid rods, ultimately caused them to break in two, leaving the floor at that point without their support. It sagged heavily, being now held up merely by the cantilever action of the floor beams, which, fortunately, are continuous from side to side of the bridge. The heavy bending stresses thus thrown upon the floor beams were entirely additional to the load for which they were designed, and, that they should have saved the situation, is a tribute at once to the excellence of the material and the forbearance of a kindly Providence.

Luckily, the sag of the roadway happened to be noticed by a bridge policeman. We say "luckily," for had a few closely-bunched trolley cars (there was no spacing of cars in those days) with a heavy dray or two, to say nothing of an elevated train, passed simultaneously on to that part of the roadway, the whole floor of the bridge would have commenced to rip away from the suspenders with accumulative action.

And what is the condition of those rocker joints today? We presume they are regularly inspected; but the millions of citizens who make use of this structure would like to feel assured that the neglect which is visible on the promenade does not extend to the bridge as a whole.

We have no wish to play the alarmist. The Brooklyn Bridge is perfectly well able to carry its present load provided, always provided, that the city officials are giving it the close inspection which every great bridge should have. Particularly is it true of a mammoth structure such as this that eternal vigilance is the price of safety.

Boy Scout Week

HOW many of us have adequately visualized the increment which was added to our great national effort of the past two years through the efforts of the Boy Scouts? Of course, we all are acquainted with the existence, and more or less with the aims, of this admirable organization; but are we not inclined to pass over its performance without a due meed of credit or acknowledgement?

When the Nation called, the Boy Scouts, then 300,000 strong, responded because they were prepared. In the first four Liberty Loan campaigns, acting for the most part as gleaners after the reapers, they sold 1,967,047 bonds, amounting to $276,744,650. They placed War Savings Stamps in excess of $50,000,000. They located 5,200 carloads of standing walnut, and collected over 100 carloads of fruit and nut pits. They distributed over 50,000,000 pieces of Government literature. They conducted war gardens and war farms throughout the country. They rendered all sorts of invaluable services to the Red Cross, the United War Work Committee, the American Library Association, and various other organizations that were serving the Government. They performed countless individual acts of service to the Government which are not recordable under any particular classification. They presented a united front of patriotic zeal in every community, which in itself was of incalculable value to the nation.

Not alone to the boys who did these things is credit due. To the hundred thousand men who have acted as scoutmasters, committeemen, council members and officials—only 250 of whom are paid, the rest being volunteers—credit is due also, and the recognition of their efforts which is involved in recognition of the Boy Scouts as a real force in the community, the state and the nation. It is for this reason that a National Citizens' Committee, under the Chairmanship of ex-Secretary McAdoo, has been formed for the purpose of expressing the nation's appreciation of what the Boy Scouts of America did during the war. This expression will take the form of a nation-wide Boy Scout Week, from June 8th to 14th. It will aim, among other things, to focus the attention of the public on what the Boy Scout movement really stands for, the immense part it played in the war, and what it is expected to do in the future.

Externally, perhaps, the prominent feature will be the effort to get into the Boy Scouts every boy who will benefit by the associations which they offer him and the ideals they hold out for him—which means every boy in America. But for the thoughtful citizen the Boy Scout will mean far more than this. It will mean closer contact with the agencies which have taken the vast reservoir of boy power, so often turned to mischievous ends, and diverted it into channels where it is of tremendous benefit alike to the boy and to the rest of us. This is what the Boy Scouts stand for.

Further Light on the Shipping Situation

IN our issue of May 17th, 1919, we referred to the views of an experienced shipowner and operator, Mr. Robert Dollar, on the shipping situation, and subsequently our attention has been directed by Mr. Hurley, Chairman of the Shipping Board, to a review of the subject by another well-known expert, Mr. J. H. Rosseter, director of the Division of Operations of the Shipping Board. Inasmuch as this is based upon 30 years of practical experience, we take pleasure in laying a digest of Mr. Rosseter's statement before our readers.

We are reminded in the first place that the amount of wages paid is to be properly measured by accomplishment, and this authority believes it would be a mistake to reduce either the wages, quality of food, or the number of officers and men employed on American ships, since his experience has proved that the more efficient service rendered is well worth the higher pay and better treatment. He admits that we are subject to unnecessary cost as the result of stupid and needless regulations in the form of tonnage measurements, a matter which should be immediately adjusted.

The above, however, are not the really important issues. Upon the Great Lakes we have, ready to hand, an example of the possible low cost of water-borne commerce. Here we find that American-built and American-manned ships are handling and carrying cargo at the lowest cost per ton in the world's commerce. If, under the spur of necessity, we have accomplished this result on the Great Lakes, we surely, by similar methods applied in a broad-minded way, may expect to achieve commensurate results in deep-sea traffic. Mr. Rosseter states that the higher cost of manning has been exaggerated, since in his experience it amounts to less than 2 per cent of the total operating expenses. This is far below Mr. Robert Dollar's estimate, but Mr. Rosseter believes that in any case, the higher cost can be more than offset by increasing the speed of our ships and bringing our equipment for loading and discharging up to date.

Another advantage over our competitors which is fundamental and permanent, is the vast supply of oil fuel which is available for our merchant marine. He states that with the ordinary reciprocating engines one-third greater distance can be steamed with a ton of oil than with a ton of coal, and the great majority of our competitors are using, and for a long time to come will use, coal. Not only is greater distance made, but it is done with a very considerable reduction in the boiler-room force. The numerous "black squad" will give way to a few men who will exchange the shovel for the valves of the oil burners. Other questions which must be faced and for which an adequate solution must be found if our new merchant fleets are to enter into successful world competition, are, first, improved types of ships and reduced costs due to American methods of labor saving, in which we should be able ultimately to lead the world. Secondly, the coördination of our railway and steamship lines—an absolutely necessary reform if we are to reduce the total cost of transportation from inland manufacturer to foreign consumer. Third, the development of efficient maritime organizations, not only at home, but in all the foreign ports of the world; for here is one of the foundation stones without which no successful foreign commerce can be built up. Fourth, shipowners and merchants must be assured of the lowest possible rates of marine insurance, at least in the earliest days of this great venture. Fifth, it is also necessary that favorable facilities be provided for foreign exchange and discounts. Lastly, and we commend this feature particularly to the careful consideration and speedy action of Congress, such conservation measures should be authorized as will assure for our great merchant fleet an adequate supply of oil fuel.

Before the war, as we have frequently pointed out in our advocacy of a larger merchant marine, it was estimated that some three hundred million dollars per year was lost to the country because of its almost complete reliance upon foreign ships for carrying its foreign trade. In the immediate future, because of the universal increase of trade and of our ability to carry not only our own exports and imports, but a fair share of the world's commerce, we believe that Mr. Rosseter's estimate of an increased revenue of over five hundred million dollars per year is not excessive.

Very apt in its application to the present era of checquered history of United States shipping is that great maritime metaphor of Shakespeare: "There is a tide in the affairs of men, which, taken at the flood, leads on to fortune." The United States stands face to face with a great opportunity, never before presented and never, in all probability, to come our way again. There is a call for farseeing legislation by Congress.

Engineering

The Lumber Production in 1918, according to tables recently published by the U. S. Forest Service, show a total of 32,760,000,000 feet. The production for 1917 was 36,000,000,000 feet, so that the past year shows a considerable decrease in lumber production; this was most marked in the southern and eastern states.

The Docks at Falmouth.—In a recent issue of the SCIENTIFIC AMERICAN we described the new docks at Falmouth. The final plans show that provision will here be made for 40,000 feet of deep-water wharves with a depth of 44 feet alongside at low water, and there will be an 1,100-foot dry dock. At first, only about one-sixth of the docks will be built, but it is possible that the British Government will show sufficient interest in these docks to have the entire 40,000 feet constructed immediately. The Government looks upon Falmouth as one of the finest sites for a terminal port and port of call in the United Kingdom.

Moving a 300-Ton Gas Container.—A recent issue of the *Engineering News Record* described a novel moving job at Portland, Ore. A gas container 70 feet in diameter and 75 feet high, weighing 300 tons, was moved a distance of three miles. First, it was raised 15 feet and loaded on rollers. Then it was moved four blocks through the city streets and lowered 28 feet to a dock, whence it was moved upon a pair of barges. The barges were towed three miles to a shipbuilding plant, where the tank was unloaded and raised 26 feet, moved across newly-filled ground for a distance of 2,000 feet, crossing a railroad track and placed on its new foundation. It took 71 days to complete the work.

Reinforcing Bridge Piles with Concrete.—A novel example of concrete work is to be found in the reconstruction of the pile foundation of a long wooden highway trestle at Port Angeles, Washington. The bridge is 2,000 feet long and crosses the bay at this point. On examination it was found that the piles had been badly eaten away by teredoes. As it was important to maintain the highway traffic without interruption, the piles were not renewed, but were reinforced by a concrete covering. Forms two feet square, inside measurement, were placed around the piles and filled with concrete. This was done during the eight-hour period of lowest tide and it was necessary to wedge the forms down to keep them from being floated as the water rose. The forms were made in six-foot lengths and if necessary were extended after the first length had been filled with concrete.

Raising a Railroad Bridge Without Interrupting Traffic.—Last year the War Department ordered the raising of the Pittsburg, Fort Wayne and Chicago railroad bridge over the Allegheny to increase the clearance by 12½ feet and required that the work be done within a year's time. The operation was performed by introducing jacks under the spans and raising the bridge gradually. The jacks were operated only when there were no trains passing and the work had to be done little by little on a single pier at a time, the operations being carried on consecutively from pier to pier, so as to avoid sharp grades. The bridge is a four-track, two-level structure and the truss spans were raised simultaneously by means of hydraulic jacks. The work was recently brought to a successful conclusion within the time specified by the Government.

Dustless Macadam Roads.—The roads at the River Rouge Naval Training Camp, Detroit, Mich., have been treated with a surfacing material of deliquescent salts which have made them dustless and also noiseless. The great difficulty with water-bound macadam roads heretofore has been to keep them at the proper degree of moisture. They were apt to be too dry, which would result in wearing away the road surface and its dissipation in the form of dust. This caused the road material to break up rapidly. If the road were kept too wet, it was inclined to become soft and would be crushed too readily by heavy loads. But in the roads at Detroit just referred to, the use of materials such as calcium, magnesium, and other chlorides from the salt wells, kept the surface at the proper degree of moisture by gathering the moisture from the air and from the soil below the road bed and retaining moisture from rains. This has been found to be effective check on dust production. A cubic yard of the material was found to cover seven square yards of road at cost of $1.25 per square yard.

Science

"Oak Leaf Poisoning of Domestic Animals" is the title of a new bulletin of the U. S. Department of Agriculture. Investigations made by the Department show that while an exclusive diet of oak leaves produces illness in cattle, and often proves fatal, these leaves are harmless if combined with other kinds of food. As small a quantity of alfalfa hay as three pounds daily, fed in connection with oak leaves, prevents poisoning. On the western cattle ranges the cases of oak-leaf poisoning occur mostly in spring, because at that season there is a scarcity of other forage.

Paradise Key.—Mr. W. E. Safford, in a lecture before the Botanical Society of Washington, recently called attention to the great botanical interest attaching to Paradise Key, an island in the heart of the Florida Everglades, some 90 miles south of Lake Okechobee. This island is unique as an example, within the United States, of a subtropical jungle unspoiled by man. Though the temperature sometimes falls below the freezing point, many tropical plants abound, including lofty royal palms, which have given the name of Royal Palm State Park to a tract of land in which Paradise Key is included. A memoir by Mr. Safford on the physical geography and botany of this region is to be published by the Smithsonian Institution.

Testing of Clinical Thermometers in Europe.—It is reported in *Nature* that since the Clinical Thermometer Order of last October was issued by the British authorities half a million clinical thermometers have been tested at the National Physical Laboratory, where more of these instruments are now tested in a week than were formerly tested in a year. It is found that about four per cent of the thermometers fail to comply with the provisions of the order. For one firm of makers, having a large output, the number of rejected instruments has exceeded 25 per cent, while in the stocks of instruments that have been sent in by dealers the rejections amount to from nine to ten per cent. The French government has recently followed the example of the British and issued an order making compulsory the testing of clinical thermometers sold in France and restricting the types of instruments that may be offered for sale.

The Earliest Plan of New York.—Dr. F. C. Wieder, of the Royal Netherlands Geographical Society, who has recently carried out extensive investigations concerning early explorations of the region about the present site of New York city, has brought to light an earlier plan of New York than any previously known. According to an account of this discovery published in the *Geographical Journal*, the map appears to have been based on a survey made in 1660, and shows a regular series of intercrossing streets, proving that even at that period, though few houses had been erected, the whole plan of the city had been laid out, even to the modern "townships." This map, which was found at the Villa Castello in Florence, is the only one thus far known dating from the period of Dutch sovereignty on Manhattan Island. The so-called "Duke's plan," preserved in the British Museum, formerly the earliest one known, appears to be, in fact, only an inferior British copy of the Dutch map.

Ships' Ballast as a Source of Plant Enemies.—In view of the well-known danger of the introduction of insect pests into this country in the earth around imported plants, it has been suggested that such pests may also be imported in the earth used as ballast in ships returning from Europe. Careful investigations of this suggested danger have been made during the last few months by the Federal Horticultural Board. War conditions greatly increased the amount of ballast brought to our eastern ports, as transports carrying troops abroad mostly returned in ballast. It appears, however, that most ballast consists of sand, gravel broken rock, and sometimes ashes. Soil, when employed, is generally derived from river banks or from excavations for construction purposes, rather than from cultivated land, and is therefore not likely to prove dangerous to plants. The sand and gravel thus arriving from abroad is usually sold for building or other construction purposes, while the broken rock and soil have been used for fills near the waterfront or towed to sea and dumped along with city waste. On the whole, there seems to be no serious danger from this source.

Aeronautical

Brazil's Aviation Service.—The Vice President, ad interim, has officially authorized, by decree No. 13417, of January 15th, 1919, the opening of a special credit to the Ministry of War for an amount of 2,000 contos of reis (about $500,000 in American currency), to be used in organizing an aviation service, buying airplanes, establishing aviation schools, and purchasing various accessories.

Radio Telephony for Range Finding.—The experiment of adjustment of fire by radio telephony was recently conducted with gratifying success at the School of Fire at Fort Sill, Okla. Qualified observers though without previous radio telephone training, conducted shoots using radio telephony instead of radio telegraphy with gun crews also untrained in this new method. The radio telegraphic equipment now available for airplane observation work is slow to operate, even with expert operators sending and receiving. The radio telephone, on the other hand, gives an unbroken communication both ways direct with the battery. The advantages of this direct communication are: Elimination of the probability of error, saving the time of relaying the message, and making it possible for the observer to send down corrections rather than observations. In fact, one trained artillery officer can easily conduct the fire of two, or even three, batteries with speed and accuracy.

Abandoned Aviation Fields.—The War Department has decided to abandon the following flying fields: Barron Field, Ft. Worth, Texas; Call Field, Wichita Falls, Texas; Carruthers Field, Ft. Worth, Texas; Eberts Field, Lonoke, Arkansas; Love Field, Dallas, Texas; Payne Field, West Point, Miss.; Rich Field, Waco, Texas; Taliaferro Field, Ft. Worth, Texas; Taylor Field, Montgomery, Ala.; and Gerstner Field, Lake Charles, La., as soon as equipment now in storage at these fields can be disposed of. The abandonment of Gerstner Field will be completed by June 30th next. It is intended to sell or salvage the buildings and improvements unless they can be utilized to advantage by some other department of the Government. The War Department has requested information from these other departments as to whether they desire to make use of any of these fields, and, if so, that further details will be supplied by the Construction Demobilization Committee of the General Staff.

Fatalities with the Christmas Strutless Biplane.—With the death of Aviator Jolly a few weeks ago, the Christmas "Bullet" has two victims as its record to date. The day following the accident which resulted in the death of Jolly, the writer of these notes happened to be eating in the Post of one of the flying fields on Long Island, where the unfortunate airman was well known and liked. Feeling was running rather high among the airmen and mechanics, who criticized the design of the Christmas cantilever plane which differs so radically from accepted practices. They pointed to the previous collapse of the "Bullet," which killed another airman. Jolly, so it seems, met with the same kind of fate; in mid-air one of the wings broke off and he was hurled to earth. These same airmen and mechanics criticized periodicals which accepted advertising for machines which are of questionable safety. They were agreed, according to the conversation, that this is a rather late day to experiment with uncertain designs.

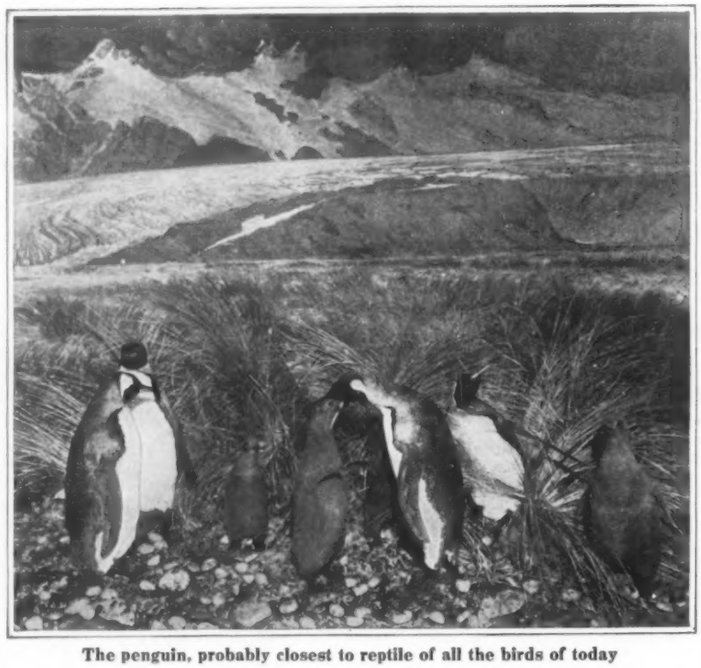
Civilian Aviation.—Before operating civilian aircraft, including airplanes, seaplanes and balloons, all persons must secure a license to do so from the Joint Army and Navy Board of Aeronautic Cognizance, Building D, Sixth and B Streets, Washington, D. C., according to the Presidential Proclamation of February 28th, 1918. During the parade of the 27th Division in New York City, a flying boat, piloted by an unlicensed civilian, flew up and down Fifth Avenue above the parade at a dangerously low altitude, estimated as between three and five hundred feet. In case of engine failure, the pilot could not have reached a landing place, but would have been forced to land in the crowd on the avenue. The Board cautions airplane operators against a repetition of such an occurrence, and warns that licenses must be secured by civilian fliers. The Army and Navy Board has control of all aircraft licenses for civilians, and points out that there is no way of adequately providing for public safety when airplanes fly at low altitudes over cities or large assemblies. Applications for licenses should be sent to Secretary, at the above address.

A Question of Identity

Were Flying Reptiles Merely Unfeathered Birds, or Birds Merely Feathered Reptiles?

By W. H. Ballou, Sc.D.

THE bird skull is divided anteriorly by a single arched bone. The reptile skull is divided by a double arch. Otherwise the structural differences are largely a matter of scales on reptiles and feathers on birds. On this rock (bone?), the greatest paleontologists have become hopelessly divided. W. P. Pycraft of the British Museum describes birds as "feathered reptiles" and "glorified reptiles." H. G. Seeley of King's College, London, declares that "there are no substantial differences between flying reptiles and birds." Baron Nopcsa, London, derives birds from "bipedal, long-tailed cursorial reptiles, which during running, oared along in the air by flapping their free anterior extremities." Robert Broom, Cape Colony Victoria College, derives birds from small Pseudosuchian, hopping reptiles of the South African Permian era. H. F. Osborn, American Museum, New York, thinks birds and dinosaurs had a common ancestor in the Permian era. Prof. Abel, Vienna, gives common origin to birds and carnivorous dinosaurs, "from an ancestor which lived in trees and had climbing feet." W. K. Gregory, Columbia University, holds that birds came up from reptiles simply by losing one of the temporal arches in the skull and by other modifications of the primitive reptiles. Finally, Prof. S. W. Williston, University of Chicago, wrote me prior to his recent death, affirming that birds always had a single arched skull and never arose from double-arched reptiles; that "all resemblances are those of convergent, or parallel evolution"; and that "we know no more about the reptilian ancestors of birds than we did 50 years ago."



The penguin, probably closest to reptile of all the birds of today

Whatever the gaps of opinion between the most able students of skeletons, their investigations have certainly developed some most interesting facts about flying reptiles and birds. Dr. H. G. Seeley, Professor of Geology of King's College, London, has presented, perhaps, the most critical analysis of the extinct flying reptiles. His conclusions are that it was only their outward appearances that became extinct, and that they modified because of food necessities into birds. In detail he says:

"So far as the evidence goes, it appears that these fossil flying animals show no substantial differences from birds, either in the mold of the brain or the impress of the breathing organs upon the bones. It is impossible to say that the lungs were identical in birds and pterodactyls, but so far as the evidence goes, there is no ground for supposing them to have been different. They were not, of course, birds, because they lacked feathers, the distinguishing feature of the latter; but feathers began to form on them in their time, as is shown in the Jurassic Archaeopterix, half bird, half reptile."

It may be also stated, with little fear of contradiction, that Marsh's fossil toothed birds of the Cretaceous were practically pterodactyls with some feathering and other small modifications. Toothed birds and pterodactyls flocked together on water ways.

It requires no stretch of imagination to regard birds as somewhat modified feathered reptiles, as they are termed by Pycraft, since reptiles have always existed in one form or another and probably always will exist. One of the last admissions of the late Prof. S. W. Williston, the great reptile paleontologist, was that it is a misnomer to regard the earlier amphibians as other than reptiles. Amphibians simply represented a more primitive age, requiring certain modifications as food conditions changed. Whatever change has taken place in the structure and appearance of animals during the ages has been due to changes in food conditions. There is nothing else that so induces change as hunger, even in modern political life. As the flying reptiles largely went into the air for larger and better food areas, their blood heated and feathers rapidly evolved from scales through friction or opposition of air in flight. Other reptiles still endure whose forefathers were either companions of the early amphibians or closely followed them. The turtle, the crocodile, the lizard, the serpent, etc., are still doing duty at the old stands, and some of them catch birds when they alight today just as they did flying reptiles some millions of years ago when they came down to earth. The wise turtles, crocodiles, lizards and serpents see no need for much change in their own structure. They go right on eating every other living creature which has improved its condition by specializations, content so long as the flesh remains juicy and satisfying.

There is nothing exciting about flight. It has always been a simple procedure with any type of animal that wanted it. Insects perfected it 25,000,000 or more years ago—just as soon as the trilobite, one of the first of animals, could get used to life out of water, change his segments and appendages and mount on wings. His lineal descendants, the dragon flies, still have to be born from eggs in water, and the young remain there four years before springing upward on wings toward the sun to dry. Exocetus, the flying fish, gathers speed in the water, rises to the surface, expands his breast fins above his back in form of a parachute and gracefully flies. Rhacophorus, the frog, an amphibian, expands the webs of his hind feet, and sails down out of trees—then climbs up and does it all over again. Maybe some day he will expand the webs of his forefeet and vault into the empyrean. Draco, the lizard, stretches out his ribs invested with skin, and volplanes out of tree tops. Gecko, another lizard, does nearly as well by merely expanding a fringe along the sides of his body like a "flying" squirrel. The bat, a mammal, with featherless wings made out of his fore fingers, flies as well and as far as almost any bird.

Pterodactyls, as primitive flyers, were just as agile in flight and just as varied in size and form as their specialized successors, the feathered birds, today. Some of them were species no larger than sparrows, others ranged up to spreads of wing greater than that of the albatross. While the pterodactyls had teeth, the American pteranodon had a horn-shell beak, although one not differing chemically from those of some birds of today, and a spread of wing in some cases reaching 20 feet. Some of the flying reptiles alighted on their feet precisely as birds do. They walked with folded wings the same as birds do, although some species are alleged, by dropping the wings with the fore hands to the ground, to have walked on four feet like quadrupeds. As to numbers, the pterodactyls were as prolific as the mind can conceive. Vast rock strata in Germany and England are crowded with their bones, where they perished presumably through the drying up of the waters and their stupidity in not knowing enough to migrate by wing to new regions. Possibly the majority of them were water reptiles from which our water birds may have arisen. The penguin, for instance, which flies only under water, is but a slightly modified pterodactyl; the latter also used its wings for underwater locomotion.

Pteranodon, the horn-beak flying reptile from C etaceous times in Kansas. The creature was a light-weight, owning to but twenty pounds

Seeley says that "pterodactyls might have lived like sea birds or in colonies like penguins." In fact, four genera of pterodactyls were as bereft of tail as the penguin. Furthermore, pterodactyls had pneumatic bones, for the admission of air, just like water birds and other types today. Very likely, some of the small species had no such air passages; for equally, some small birds of today have none. Pneumatic bones predicate a four-chambered heart, common to birds and mammals, and hence warm blood. For that matter we have warm blooded fishes, such as the giant mackerel and the flying fish. Even the crocodile has a four-chambered heart. In consequence, it may well be assumed that there were both warm and cold blooded flying reptiles, the alternative depending largely upon the

activities of an animal. The feet of the pterodactyls were distinctly reptilian. It is particularly in this respect that birds, during 5,000,000 years, have specialized to better types. Williston accounted for this by assuming that the pterodatyl foot was used solely for flight and never for walking. His premise, however, was not well supported by his evidence. He described the Kansas pteronodon, a beaked flying reptile, as having a head three feet long, a stretch of wing of some twenty feet, and a weight of only 20 pounds. If a bulky ostrich can run faster than a horse on two slender toes, certainly a gigantic pteranodon, weighing only 20 pounds, could easily walk on weak toes with rudimentary claws and a free-moving femur, "giving great freedom of movement to the hind legs."

Flying reptiles and birds have practically identical shoulder girdles, keeled sternum (breast bone) and forelimb bones. The flying reptile Rhamphorhynchus and the fossil bird Archaeopteryx each had long forearm bones, with hands terminating in three sharp claws and identical long tails. The fossil bird, so called, Ichthyornis victor, from the Cretaceous beds of Niobrara, Kans., had the small, elongate brain of a flying reptile and the same, sharp pointed recurved teeth. Like other species of fossil birds collected there by Marsh of Yale College, he was not only associated in life with pterodactyls, but might have been a modification of one on the spot, as it were. Marsh collected thousands of bones in the Niobrara beds, of flying reptiles and so-called fossil toothed birds, many of which to this day remain unsorted, men of science having been unable to tell which is which. Of course, in classification, we must distinguish as birds those which we know have feathers, but the trouble is that we do not know that all of the many species of flying reptiles were featherless. Scientists dodge the vital question by placing flying reptiles on two lines, very close together, coming up from a common stem, or common ancestor.

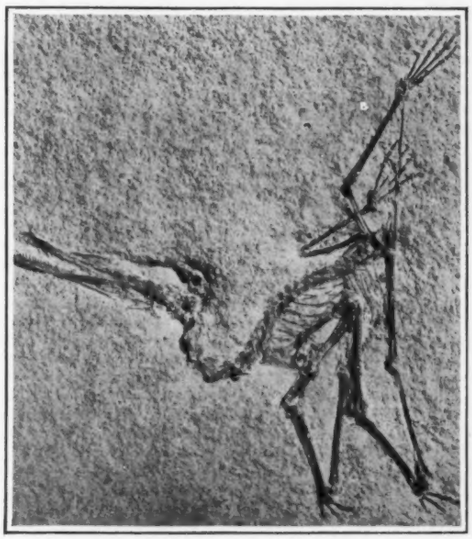
Dr. W. K. Gregory, of the American Museum of Natural History, New York, recently addressed the New York Academy of Sciences on the origin of birds. He said:

"The skull of birds is of a modified reptilian type and has no doubt been derived simply by the loss of the upper temporal bar, by the inturning of the pterygoid bones and by the enlargement of the internal nares. In short, the whole architecture of the bird skeleton, as indeed the whole internal anatomy, are unquestionably a modification of a primitive reptilian type. The consensus of opinion is that the common ancestor was nearly related to the primitive Archosauria, or reptiles with two arched skull bones. Far back in the Carboniferous ages, the remote common ancestors of birds, dinosaurs, flying reptiles and other reptilian groups were very primitive lizard-like reptiles with extremely small brains, comparatively sluggish habits and a highly variable temperature. Euparkeria, according to Broom, a small reptile in the Permian of South Africa, exhibits incipient adaptations to active hopping on two feet. Its structure was so generalized that the diverse peculiarities of birds and flying reptiles could readily have been derived from it. In some types of these Pseudosuchians, the body is known to have been covered with horny plates, but others may have been clothed with overlapping scales which must have preceded the evolution of feathers, the critical steps in the evolution of birds."

A man is as he thinks, and thinking is a function of the brain. If a bird has a reptile brain, it must think largely in the terms of a reptile. In the sense that clothes make the man, feathers make the bird. Hence, the bird is merely a flying reptile, feathered more or less according to species. Man has a little of the reptile structure left in him, but a bird has little else. Feathers, then, merely conceal the reptile. When Robin Redbreast lifts up his head and pours out its morning song, the brain that guides it is almost identical with that of the young alligator, which, while it cannot sing, bays and roars pretty loudly. Mrs. Robin lays an egg and so does Mrs. Alligator.

Francis W. H. Clay

AFTER an illness of two weeks, Assistant Commissioner of Patents, Francis W. H. Clay, died at his residence in Washington, on Saturday morning, May 10th. Mr. Clay was born in Richmond, Ky., February 9th, 1869. After graduating from Cornell University, he served a brief term as Assistant Examiner in the Patent Office, resigning in March, 1900, to enter private practice. He pursued this successfully in Pittsburgh until 1916, when he accepted the place which he held until his untimely death.



The pterodactyl, flying reptile with teeth, as preserved in fossil form in Germany

Mr. Clay, from the family of distinguished Kentucky statesmen, possessed to a marked degree many of the characteristics of mind and character which have made that family notable. His personality and attainments made companionship with him a delight and an inspiration. It is not strange that one with his inquiring mind and capacity for research should have entered the field of invention. As evidence of the fact that his mind did not operate along a single track, we have the fact that he himself was grantee of patents for inventions in several lines. As a lawyer he stood high, both with the bench and the bar, and served his clients with signal ability. As a public servant he was upright and above reproach, and executed the duties of his office with distinguished ability possessing that happy combination of mechanical insight and judicial-mindedness which is so necessary in the adjudication of patent matters.

Good Flotation Oils from Crude Tar Products

THE new "flotation" process for the concentration of various sulfide ores has had a very rapid development in the last few years, and as a result the demand for flotation oils to use in the process has been very great. Pine oils and tar oils obtained by the distillation of southern pine have become standard flotation oils, but the tar oils obtained by the destructive distillation of hardwoods have not been used so widely.

Recent investigations by the chemists of the Forest Products Laboratory, U. S. Forest Service, and the Bureau of Mines have shown that several hardwood tar oils have a very high flotation value. Some of the crude tar products obtained in the ordinary operation for making wood alcohol made especially good flotation oils and in general these crude products were better than any of the redistilled oils obtained by further refining. The presence of pitch, which is supposed to be detrimental to pine tar oils, was found to be not only harmless in the case of hardwood tar oils but even desirable.

These discoveries should make available to the mining and smelting companies a large supply of flotation oils and should furnish a market for wood distillation products hitherto used largely as fuel at the plant.

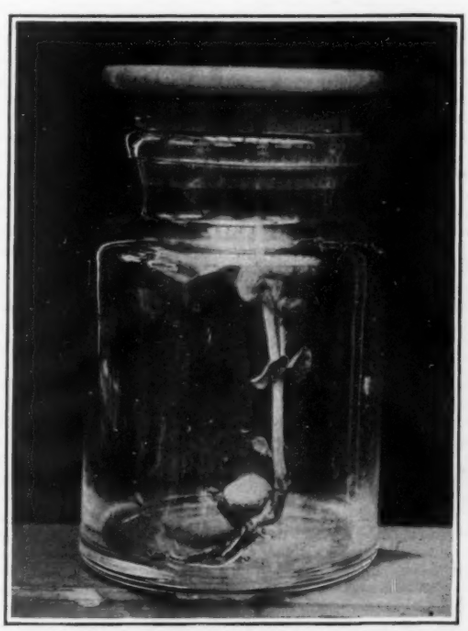
Phosphorescent Landmarks

A CLEVER and novel use of luminous paint is being made at the British front. There are a number of faintly luminous phosphorescent substances, such as those having a basis of radium salts and the sulfurous compounds studied by Becquerel, which give off a faint glow, like that from the firefly, at night or in a dark room. These have long been used for making small objects, such as watch dials, match boxes, etc., visible at night. An ingenious extension of such applications of luminous paint has recently been made in the British army at the front. Large wooden disks or buttons about 2½ inches in diameter are coated with the aforesaid phosphorescent paint and then covered with a protective layer of celluloid. These disks have a sharp point on the reverse side by means of which they can be affixed to the ground and the sides of trenches, or other earthworks, or to buildings, fences and other structures. They are perceptible at a distance of from 30 to 60 feet. This low degree of visibility is one of their advantages, since they form admirable landmarks for the troops and scouting parties, but are invisible to the enemy, either on the other side of No Man's Land or in the air. They retain their phosphorescence for several months before needing to be replaced. These disks are also used in the hand for giving optical signals, orders and information at a short distance when silence is desirable. In a similar way luminous ribbons are placed along a road by day to indicate the path to be taken at night. Sometimes, too, luminous letters and arrows act as guide poles, and finally, luminous devices placed on the backs of stretcher bearers protect them from being fired upon by their friends. The pertinent suggestion has been made that such signs would be very serviceable for the names and numbers of streets.

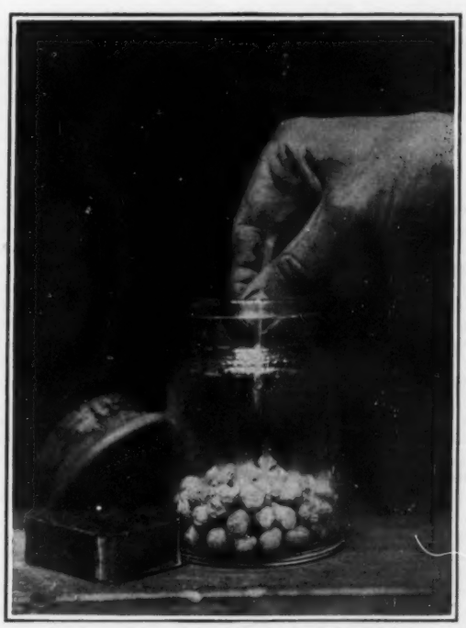
Do Seeds Breathe?

IT is easy to demonstrate that germinating seeds take in oxygen and give out carbon dioxide. A score or so of peas are placed in a close fitting jar with a small amount of moisture. After a while the peas start to germinate, but soon they cease all development, because the oxygen in the jar is exhausted. A single pea in a jar of the same size, however, will develop and grow up into a little plant. There is evidently enough oxygen for the needs of the single specimen.

To prove conclusively that there is no oxygen left in the jar in which the number of seeds germinated it is only needful to plunge in a burning match. This instantly goes out. The presence of carbon dioxide in this jar is clearly shown by pouring into it lime water, and then shaking. The lime water becomes milky in appearance. This would not happen to any extent in a jar in which there had been no germinating seeds.



The jar contains enough oxygen to support the growth of a single pea-vine



But a score of peas rapidly exhaust the oxygen and cease to grow

Patents and Profits

Why Does an Inventor Sometimes Fail to Receive the Expected Reward?

By Dudley T. Fisher

IT is notoriously the opinion of a very large number of people that poor but honest inventors are usually robbed of their inventions by wicked capitalists who amass fabulous wealth by the exploitation of their ill-got ideas through the agency of patent monopolies.

Last summer one of the New York papers carried a picture of a woman candidate for Congress and accompanied it with the statement that one of the planks in her platform was *"the abolition of all monopolies, including patents."* It really seems to be the belief held by a great many people that a patent is a monopoly which works to the advantage of the capitalist class at the expense of the masses. I believe that all such criticisms arise from an entirely erroneous conception of the nature of the monopoly granted by the United States in a patent for an invention.

When man first advanced beyond the apes he did not recognize property rights, and the strongest man kept the best bunch of bananas for his own use. He gradually learned that with a spear a resolute man could protect his bananas from a fellow who was somewhat bigger and stronger than himself. He then learned that his favorite spear was something which he desired to keep for his own use, and there gradually grew up a recognition of the rights pertaining to personal belongings, or as we say today, personal property rights. When, later, men began cultivating the soil, each man asserted his rights to the possession of the crops which he had planted and tended. He soon learned that better crops could be grown in some fields than in others and so asserted his preference for planting his crops in the most desirable fields. In this way there gradually grew up a recognition of the ownership of land. Thus it was that the rights of personal property and land were very early recognized, and very thoroughly developed. But the recognition of an idea as property required a very much higher development of society.

For instance, when the minstrel sang a new song, that song became the property of any person who could remember it to sing it. With the invention of printing it became possible for any fellow who heard the minstrel sing to record the song in such form that he could sell it to the public, and the people no longer cared to pay the minstrel for singing. Thus the minstrel lost something of value which had formerly been his, and there ceased to be any incentive for him to sing. So there became fewer new songs and the public lost what it might have had if the minstrel had been assured of a proper reward for producing new songs. In order that minstrelsy might not be destroyed the people agreed, through their duly chosen representatives, to recognize the minstrel's song as property, only requiring that a record be made of the song so that it might be possible to know whether the printer had really stolen that particular song or had produced a new one of his own. In the same way it gradually came to be recognized that a man who discovered a new way of doing some useful thing should be protected in the use of his discovery in order that he might be encouraged to work out such improvements. And this marks the beginning of patents.

Nobody ever thinks of terming the exclusive possession of personal property a monopoly, although, according to the strict definition of the word it certainly is one. It is also true that the people who object to monopolies, with the exception of a few of the most advanced socialists, would balk at applying the word monopoly to the exclusive enjoyment by a farmer of his farm, and it seems a pity that the obnoxious word should have been coupled with the recognition of ownership in ideas.

One very important thing to be remembered, when considering the character of the monopoly granted by a patent, is the fact that the inventor, by exercising the rights granted to him by his patent, is not depriving the public of the enjoyment of anything which the public had previously enjoyed. When a monarch granted a monopoly to the glove maker he curtailed the privileges of the balance of the people, but when a patent is granted to an inventor, it is done with the express provision that the monopoly relates to the enjoyment of rights to things which had never before existed, and that monopoly is granted as a reward for bringing those things into existence, so that the public may enjoy them at the expiration of the term of the patent.

The conditions upon which the patent is granted are, first, that the invention must be new. If it has been known before, the inventor cannot have a patent. Second, the invention must be useful. If not useful there can be no occasion for granting such a monopoly and the government regards the matter as too trivial to justify consideration. Third, the inventor must make such a full disclosure of his invention and the manner of using it that the public may have full possession of the invention at the expiration of the term of the monopoly. These are the conditions which are imposed upon the party of the first part to a contract between the inventor and the public. In consideration of the benefits bestowed by the invention the party of the second part, that is the public, pays to the inventor a recognition of his ownership in his ideas for a limited time. The inventor need not make known the fact that he has an invention. He may, if he can, keep the matter entirely secret. But experience has shown that it is a very difficult matter to use an invention and keep it secret at the same time, and that it is very good business, both on the part of the public and the inventor, to pool their issues. The public pays the inventor what his invention is worth, and the inventor uses his talents to supply the public with what it wants.

But, you will tell me, there are many inventors who do not reap the rewards which the patent leads them to expect. I believe the greatest cause for this complaint is the ignorance, on the part of the inventor, as to just what he has invented. It is almost the universal opinion of the inventor that he has invented more than he really has done. The more inexperienced the inventor the greater is his overestimate of his invention. Every few weeks I have submitted to me drawings from men who operate machines built by the company with which I am connected, showing new machines which they claim to have invented, and which they wish to sell to our company. There is sometimes a rudimentary shadow of an invention in these machines, but usually they are only new arrangements of the parts of machines which we have already built, and often the rearrangement would result disadvantageously in some particular of which the alleged inventor is entirely ignorant.

Another reason for the failure of an inventor to receive the expected reward, is inefficient work on the part of his attorney. The description upon which his monopoly is founded is often so poorly written that the very essence of the invention is not told, and when the inventor tries to enforce his rights he finds that his contract with the public does not cover many points which are essential to the practice of his invention. I have found that in a large majority of cases, the mind of the inventor is so full of some detail which has occasioned him more study than the balance of his construction that he has entirely forgotten to inform his attorney of some of the most important points of the invention. Later on when his machine has been developed in actual practice, he finds that the points which he talked so much about to his attorney are of comparatively little importance, and that the things which are really essential had received very little if any attention from either the inventor or his attorney. Of course, good patent writing is just like any other kind of work in that it cannot be done cheaply. If the best results are to be obtained, there must be no skimping either in labor or material.

Another reason for an inventor not receiving the expected reward is that he invents something which nobody wants. After an invention is perfected and patented, the only way to profit by it is to sell either the devices invented or the patent. If no one wants such devices, the mere fact that they are patented will not make people pay for them, and the inventor fails of a reward. I knew an inventor who made an improvement on a certain make of airbrake. The improvement did not apply to airbrakes of any other make, and the only possible customer to whom he could sell his patent was the one manufacturer. After he had gone to the expense of developing the improvement, building a model and securing a patent, he solicited this company to purchase his patent. They told him that they recognized the fact that his invention was an improvement, but it would not add enough to the selling price of their apparatus to justify them in paying for his patent and in changing their designs to conform to it. As noboby else could use the invention it was not necessary to purchase his patent to prevent its falling into the hands of their rivals and there was another disappointed inventor.

One very important consideration connected with the procuring of profit from inventions is development. Until a machine is worked out into its commercial form it cannot be successfully placed on the market. Often it requires more high class invention to produce the necessary tools with which to build a machine than was required to invent the machine itself. This fact is one of the most important justifications of the patent system. When Francis Lechner invented his first mining machine, he was years away from its successful application to the mining of coal. He produced a remarkably crude model which convinced Joseph A. Jeffrey that the idea was feasible. Engineers were employed to design a practical machine. This machine was built and taken to the mines and it failed absolutely, not through any fault of Mr. Lechner's invention, but because the strains were heavier than the engineers had estimated. This machine demonstrated what the strains were and a second machine was built which really did work. However, during the first year or two the machine went through a course of development which changed its appearance so much that its own father could hardly recognize it. All of this development cost more money than was got out of it during the first few years and it was only because the people who were behind it had sufficient capital and enthusiasm that it was finally placed on a paying basis. If either the capital or the enthusiasm had given out before that result was accomplished, there would have been another disappointed inventor. Without the protection afforded by the patent, Mr. Jeffrey would not have invested the necessary money and enthusiasm in development to make Mr. Lechner's unpractical model operative.

After a machine has been invented and developed, it must be introduced to the public. That is, the people must be educated as to the advantages to be derived from its use. This is often more difficult than to overcome the mechanical difficulties of its invention and development. Often there are age long traditions and prejudices to be overcome. The development of a market often requires the expenditure of thousands of dollars which can only be repaid from the profits of prospective sales. If persons who have borne no part in the labor and expense of producing a successful machine, of introducing it to the public, and of overcoming the ignorance and prejudices of the people, are allowed to share in the profits of such effort, there will be small incentive for any one to take the very evident risks, pains and labor involved in its production.

In some countries patents are issued with the provision that if the patentee does not manufacture within a certain specified time any person who desires to manufacture under that patent may apply to the Court and receive a license under such terms as may seem just to the Judge. From my point of view this provision seems to be very unfair. Suppose that John Doe has invented a machine for a certain purpose which is entirely new. He obtains a patent, spends thousands of dollars in development, spends other thousands of dollars in advertising and introduction, and succeeds in building up a business which in time will pay back his initial investment and yield him a good profit. Richard Roe, after seeing Doe's machine, sees another way to accomplish the same result. He simply draws a picture of his proposed machine and secures a patent on the basis of that disclosure. He offers his patent to Doe, and because he has not spent any money, and very little thought on his invention, he is willing to sell his patent for a very moderate sum. Doe buys the patent to prevent the destruction of his newly created market and both are perfectly satisfied. The profits on Doe's machine have not yet absorbed his initial investment, and these profits would be seriously curtailed by the introduction of a new design, so he simply holds the Roe design in reserve until such time as a new design shall be necessary to maintain the market.

But now a third party, who has had no part in the development of either machine, and who has expended neither money nor effort on the matter, sees an opportunity to break into Doe's market. He applies to the Court for a license to build the Roe machine, alleging that there is a great demand for the machine which Doe refuses to supply. He does not, however, state that this demand was caused entirely by the advertising and development work done by Doe. The Court grants the license, fixing a royalty, which on the basis of the probable selling price, but not taking into account Doe's initial expense, seems to the Judge to be reasonable.

Does the public gain anything by this transaction? I think not. There are now two manufacturers from whom the public may purchase such machines. One of these manufacturers has had no initial expense to absorb in his selling price so he cuts under Doe's price and steals the market. The price to the public is somewhat lower than it would otherwise have been. But Mr. Doe, being a

(Continued on page 587)

French Naval Policy and the Lessons of the Great War

A Brief Study of the Ships of the War and Their Performances

By Robert W. Neeser

IN the light of experience, the operations at sea during the Great War have served merely to confirm the previous teachings of history that sea power has played a decisive rôle in the existence and growth of the French nation. France was saved by her army on the battlefield of the Marne. But without her navy, which placed at her disposal the industrial resources of the Western Hemisphere and assured her the transportation of important reinforcements of men and material at a moment when victory hung in the balance, the heroism of her soldiers and the genius of her chiefs alone could never have followed up this first success and reaped the final victory four years later.

A glance at the chart will reveal the fact that France enjoys an enviable situation for a maritime nation. Her coasts, washed on three sides by the waters of the Atlantic Ocean, the North Sea, and the Mediterranean Sea, lie in the very path of the commercial sea routes which today join Europe with the markets of the world. It has been said often that the French people have not known how to realize this great opportunity and that blinded by many successes of their arms on land, they have allowed their attention to be diverted from what has really been the foundation of their greatest victories—sea power.

The naval policy of France in the years which preceded the outbreak of the war was characterized by a vaccilation which revealed a misunderstanding of the true principles of sea power. The consummation of the entente between France and Great Britain, however, solved the problem created by Emperor William's maritime aspirations, and assured the Allies such a preponderance of force on the high seas, that the German Fleet was reduced to a rôle of comparative inactivity. Only once, during the month of May, 1916, did the High Sea Fleet venture to engage the British Fleet in a general engagement. The result of that day's battle off the coast of Jutland merely reaffirmed Britain's command of the sea, and the months of silence and inactivity that followed Admiral von Scheer's precipitate retreat were broken only by the signing of the armistice by which Germany renounced forever her aspirations on the sea.

It was then that Germany, deceived in her fondest hopes, launched her campaign of intensified submarine warfare against the merchant fleets of the whole world in a desperate effort to strike at her enemies' exposed lines of communication. During the first few months, the number of submarine sinkings reached such alarming proportions, that for a time it seemed as if U-boats threatened to sweep everything before them. It was an enormous and difficult task that confronted the French and British navies, which has no parallel in history. But little by little, the Allies improvised measures and devised tactics to combat their dreaded undersea foe, until the German Admiralty, in despair, acknowledged the failure of its trump card and last hope of success.

But if the war on the sea has brought into evidence the rôle played by the powerful battle fleets, the distant patrol cruisers, the flotillas of destroyers and other torpedo craft, and the scores of auxiliary and converted craft that were added to the French navy since the outbreak of hostilities, it has also emphasized the fact that none of the allied maritime nations would have been able to survive the strain of the last four years if they had not had numerous merchant fleets to second the efforts of their fighting fleets, and innumerable coaling and supply bases, wireless stations and telegraphic cable lines to facilitate their operations. This is what the French Minister of Marine doubtless had in mind when he declared that, in his opinion, France should without delay formulate a naval policy commensurate with her commerical, economic and colonial aspirations; for all four policies are so closely interrelated, that to neglect one is to jeopardize the success of all the others; and no one can deny that all four today are vital to the future of France to enable her to reconstitute her national wealth, assure her economic development, maintain her vast colonial empire, and enable her to maintain her position among the great powers of the world.

Now that the hostilities on the sea are at an end, the ships of war will again be available for service in distant waters, where their mere presence has always assured the prestige and authority of the nation they represented, and paved the way for the activities of the merchant vessels that followed in their wake. Commerce always follows the flag, says an old proberb, and the truth of that saying has never been disputed. This is the motto which is being urged in France today in an effort to rouse the people to the necessity of creating a large merchant marine. "A few months ago," wrote the naval critic of the *Temps*, "it was a question of making every sacrifice in order to obtain a decision on the battlefield. But now that the victory has been won, our thoughts should go beyond the immediate present and seek to picture the possibilities of the future that lies before us."

And these possibilities of the future will also in a great measure affect the naval policy which France may adopt as a result of the negotiations now being held with a view to assuring a lasting peace. In this the project of a League of Nations is bound to have a far-reaching influence; not that it would in any way limit France's aspirations upon the sea, for her construction programs, for obvious reasons, have always been extremely moderate and reasonable, but in so far as the "zones of influence" of the navies of the world are concerned. For the sentiment that is fast gaining favor is that the pact of the League of Nations will involve a sort of internationalism of the fleets of the world, in which each naval power will have a specified and limited zone to patrol in the interest of the world's peace. For France, this zone would most logically be the Mediterranean Sea and the water touching the western coast of France. There her duties and responsibilites will be clearly defined, and her naval ascendancy undisputed by her Allies and neighbors. This does not mean that, in the interest of commerce, French cruisers will not be allowed to visit other waters "pour montrer le pavillon." On the contrary such cruisers will continue to afford opportunities for the exchange of international courtesies, as well as enable each power to keep in close touch with its colonial possessions and its commercial markets in zones patroled by other maritime members of the League of Nations.

In a recent article in the SCIENTIFIC AMERICAN it was shown to what extent the French navy had been increased by new construction during the war. Since the signing of the armistice only vessels which were actually on the ways have been completed, and as fast as these could be launched, merchant craft of every type and description have been laid down with a view to anticipating the future needs of the nation.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

How Best To Make the Airplane Safe

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of March 8th last, Mr. Gaetan Ajello under the above caption has added much to what has been advocated in public prints before and since the armistice on a topic needing no greater emphasis than the statistical fact that an average of nearly two stalwart men a day have perished in the training of our airmen for the German War. The fatalities are still cumulative and seemingly point to a time when life-saving equipment will be made compulsory by legislative mandate for air navigation, as in due course it was made compulsory for water navigation.

However well Mr. Ajello's idea of emergency wing or other surface as part of a machine, stabilizing itself automatically yet engaging the air at will for safe landings, may work out in practice, I quite agree that life-saving devices should be no part of air travelers' dress or personal equipment. As to strapping pilots and aides to their seats in peace times that is obviously no more necessary than automobile drivers doing likewise.

Looping-the-loop and all such maneuvers may be permissible in war, but in the interest of this art as it may apply to commerce, all such evolutions I submit should be, and will be, prohibited by rules and regulations, if not by law. A modification of what follows may very well be made to "act as a brake when required, especially in avoiding collision in close formation" as also for landings.

Like all such problems the *sine qua non* of this is plainly simplicity. Every one who has observed a balloonist cut loose his parachute for a drop to the earth knows that the balloon, relieved of its load, springs upward like a bouncing ball and the fall is unobstructed, yet safety still hangs on the chance opening of a parachute. Aviators, however, may reverse this operation and reduce enormously the risk by opening their parachute before stepping off and thereby retard their drop which would be equivalent to a lift up and away from falling or fast traveling aircraft. Such automatic working is readily attained with air compressed in handle of parachute. All that is required is a tire valve, air pump and push button or its equivalent to release the air into air ducts incorporated in the fabric.

Thus merchandise, mails, pilots, aides, passengers or troopers for strategical purposes in war may be landed with safety without bringing the machine to the ground. Also escape from burning machines. For prudential reasons all fabric should be made fire-resisting by saturation with non-combustible solution. I submit that such equipment would save many lives in low-altitude accidents of 200 feet, or possibly less, if promptly used. Of one thing we may be sure that whatever arrangement for life preservation shall be used in the future there must be certain coördination and accommodation of the machine as a whole to it, and it to the machine.

Many are possessed with the notion that it is necessary to provide a parachute from 18 to 25 feet in diameter to drop the average man. That is wrong provided data tables are right. It is all very well for professionals to linger above the crowds for spectacular display and soft landing. The airman's requirement is to land right-end up without broken bones, and for that 15 feet diameter seems ample. According to the tables of retardation of weight acted on by gravity a "15-foot diameter parachute will drop 220 pounds 7.58 feet per second, equivalent to jumping 11 inches." which surely seems a safe margin.

The factor of weight is of course of much importance. The writer had opportunity recently to weigh 177 square feet of government parachute silk, which would be equal to 15-foot diameter circle. With this was 12 suspension cords of nearly 500 pounds combined tensile strength.

All together they totaled slightly over two pounds weight. With compressed air reservoir handle such an apparatus would weigh about four pounds total—call it five pounds. The figures will be illuminating when we compare a commercial machine carrying, say 30 passengers each, passenger equipped with life saving device weighing say 25 pounds. Using these figures it will be seen that the ratio of added weight would be as 150 pounds is to 750 pounds. Surely quite an item to add to the surplus load capacity of any type of flying machine.

SAMUEL D. MOTT.

Passaic, N. J.

Helping the Salvor in the Shipyards

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of January 18th last you wrote on the above title. With usual precision you thereby turned the limelight on a weak spot in the fabric of economic progress.

The value of your suggestion assumes its true magnitude when a thought is given to the thousands of ships and cargoes sunk during the war. Is it not to the advantage of underwriters to insist on this safety measure in line with others, which they now require, before insuring a ship and cargo? Is not the general public, who in the end pays the bill, interested in seeing that everything possible is done to safeguard life and property at sea? Had the "F-4" had such means the lives that were lost would probably have been saved.

Engineers know, and modern salvage equipment will convince salvors, that your suggestion warrants serious thought, lest we forget one of the most expensive lessons taught us by this war. Such means as you suggest with approximate strength of perhaps 200 tons each, can be very economically placed; say 24 feet apart along the sides and above waterline. With an operator protected by any sort of a diving bell ship salvage from 1,000 or more feet could then in the future be accomplished speedily and economically.

Will you not publish this in order to invite discussion of this important subject?

CARL J. LINDQUIST.

New York.

Oddities of the Trans-Atlantic Flight

A Review of the Attempts of the C-5, Sopwith, Martynside, and NC Entries

The NC-4 taxiing on the surface at Trepassy Bay, preparatory to the Newfoundland-Azores flight

AFTER all, the crossing of the Atlantic is not a simple feat. In fact, it is far more difficult than had been anticipated. Four and a half years of forced aviation development due to the keen rivalry between warring powers, had led aviation men and the world at large to believe the trans-Atlantic flight well within the possibilities of present-day machines. One machine after another was featured as quite suitable for the long journey. Yet the efforts of the past few weeks have served to bring home to everyone the inherent weakness and uncertainty of the airplane and the dirigible, as developed in long-distance flights and in adverse weather. Indeed, there is no immediate danger of the steamship lines going out of business!

As our last issue went to press, we learned of the unfortunate disaster which put the U. S. Navy dirigible C-5 out of the contest. This small dirigible, measuring under 200 feet in length, had made the flight from Montauk Point, Long Island, to Newfoundland in good time and shape. Arrangements were completed for the start of the trans-Atlantic flight. Everything seemed in favor of the dirigible. As luck would have it, however, a wind storm came up and the dirigible was torn away from its moorings and blown out to sea. Since then no trace of the dirigible has been found.

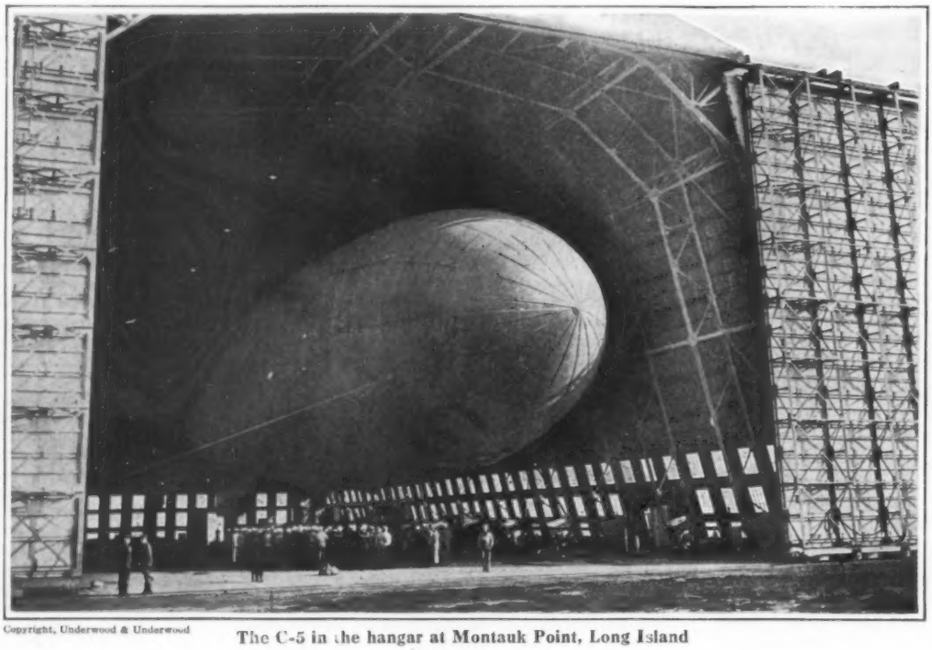
From an authentic source we learn that the C-5 left Montauk Point with about 525 gallons of fuel. The passage to the "jumping off" place at Newfoundland required but 200 gallons, and there still remained somewhat in excess of 300 gallons in the tanks. When the C-5 reached Newfoundland there was a steady, favorable wind blowing in the right direction, and the crew were anxious to take advantage of it. But their orders were to land; and they landed and anchored their dirigible in the open. If the dirigible had pushed on across the Atlantic, it would very likely have made the crossing at an exceptional speed.

Everything performed to perfection in the C-5. The Union engines were at no time pushed to the utmost. An interesting feature of the Montauk-Newfoundland flight was the burning of surplus hydrogen in the engines. Instead of releasing the hydrogen into the atmosphere, it was introduced in the engines together with the required amount of air. This procedure resulted in considerable economy of fuel.

As for navigational difficulties, it is learned that the radio direction finder served to good stead. On more than one occasion the radio operator came to the rescue of the navigation officers and told them the position of the dirigible. But owing to the fact that the directional wireless only gives the line of a station sending signals but not its position on that line, the C-5 was "lost" for a few hours toward the end of its flight. However, under regular conditions the directional wireless has proved of considerable aid in aerial navigation. The operator determines the position of the sending station by noting the intensity of the signals. After he determines the line of the signals, he has merely to note whether the signals grow louder or weaker to determine whether he is approaching or receding from the station.

As for the disaster which befell the C-5, it is said to have been absolutely unavoidable. The wind was blowing at a high velocity and most lustily. One after another of the heavy anchoring ropes and steel cables were snapped, as the strain came on one after another as a result of the changing winds. Finally, when it was evident that the big gas bag would be blown away, the rip cord was pulled by the last man aboard the dirigible. It broke just short of the part engaging with the gas-bag patch. And just as the bag started on its wild journey, carrying the dangling car below it, the last man aboard jumped some twenty feet to the ground.

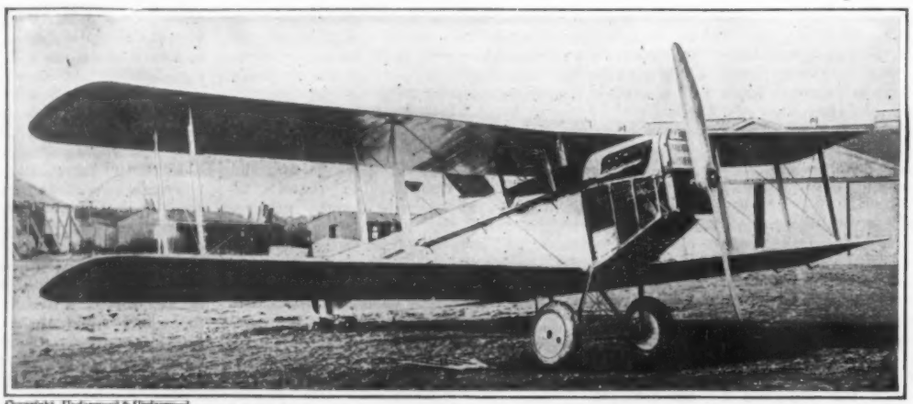
A dirigible, unlike an airplane, is safer in the air than it is on the ground. For in the air it rides with the wind and is not subjected to great strains, whereas on the ground it is securely tied and under the blows of the wind is subjected to severe strains. Had there been a shed to receive the C-5, the accident would not have happened. Again, if the dirigible had been tied out to a mooring tower, as the British have done with their small dirigibles, the wind would have caused little if any damage. So all in all the disaster serves once more to indicate the vulnerability of the dirigible on the ground, and the necessity of mooring towers or housing facilities.



Copyright, Underwood & Underwood

The C-5 in the hangar at Montauk Point, Long Island

Then there has been the ill-fated attempt of Hawker and Grieve, who started out on the great flight on Sunday afternoon, May 18th, from Newfoundland. If everything had gone well, this Sopwith team would have reached the coast of Ireland the next day, some 20 hours after their start. At first there were wild rumors of the sighting of the Sopwith off the coast of Ireland and even above certain districts of Ireland; but as time passed these rumors proved to be unfounded. At the present writing, four days after the start of these intrepid airmen, the world is without word from them, and it seems certain that they have met the same fate as another of their countrymen, Gustave Hamel, who set out across the English Channel and was never heard from again, as well as the Frenchman, Lieutenant Bague, who set out across the Mediterranean.



Copyright, Underwood & Underwood

Hawker's Sopwith biplane, equipped with a 400-horsepower engine

While the Sopwith carried a wireless set, no land station or steamer picked up messages from the airmen. Not even a farewell message came back to the associates of the Sopwith team at Newfoundland. Yet the wireless set had a range of over 100 miles, and it would seem that at some time the biplane was within that distance of some of the trans-Atlantic liners and freighters.

Little hopes were entertained for the Sopwith undertaking even before the flight. Heavily loaded, the Sopwith biplane had to keep its engine going at the full output, until the load became lighter as the goal was approached. That meant a

severe strain on the engine. In all, the flight was to take more than 20 hours' time; and it was regarded as problematical in the extreme whether even the best aviation engine could maintain its full output over so long a period. Then again, with a crew of two, only one of which was the pilot, there was the great danger of falling asleep. Military airmen engaged in long-distance night bombing have complained of the difficulty of keeping awake during long flights. The steady drone of the engine, the effect of the clear, cold air, and the general ennui of such flights results in sleep. Hawker was a flier of long experience and no doubt knew how to guard against falling asleep. Most likely of all, the engine broke down as a result of the long strain, or the airmen met adverse weather conditions and exhausted their fuel. Again, they may have drifted far off their course and run short of fuel.

All in all, the Hawker attempt has justified the general skepticism towards the single-engined machine for the trans-Atlantic flight. The betting odds were 20 to 1 against Hawker landing in the British Isles—and they were certainly not too heavy. Unless an attempt is to be something aside from a mere gamble with what appears to be certain death, a multi-engined machine must be employed.

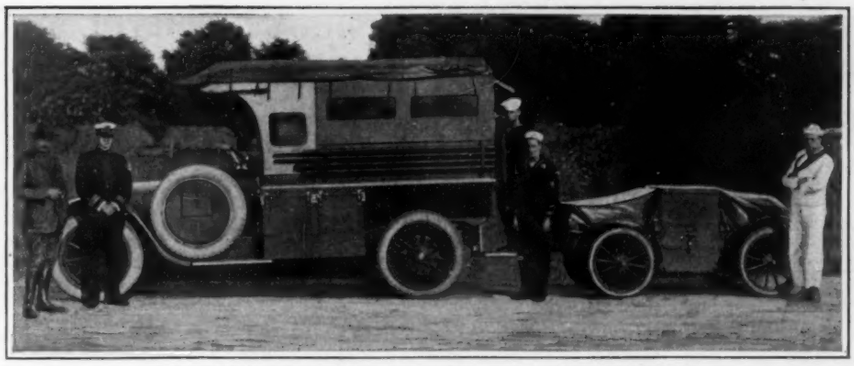
Turning to the Sopwith's rival, the Martynside, manned by Raynham and Morgan, it is interesting to note how this supposedly sturdy machine broke down while starting. From press accounts it appears that the Martynside was rolling along at about 50 miles an hour for the "take-off," when it struck a little mound which broke the undercarriage and damaged the machine beyond immediate repair. This accident brings out the fact that a small trans-Atlantic machine must be loaded to a point where it is difficult and even dangerous to "take-off" unless the flying field is well-nigh perfect.

Meanwhile our NC boats have been in for an exciting time. Starting from Trepassy Bay in Newfoundland, the NC-1, NC-3, and NC-4 had every chance of making the flight a success. Destroyers were strung along the route, ready to offer succor if necessary, as well as emit wireless signals for the direction of the airmen. Yet only one NC boat came through the 1,200-mile flight, namely, the NC-4, which was the very plane that experienced no end of troubles and breakdowns on the way up to the "jumping-off" place.

The NC-1 was forced down to the surface, and sank off Corvo, the U. S. destroyer "Fairfax" being unable to salvage her. The crew, however, were saved. The body of the machine gradually gave way under the pounding of the heavy seas, and the wings were broken off. As the water continued to fill the body, the machine slowly settled out of sight.

The NC-3, the flagship of the trans-Atlantic fliers, got off the course and in time ran short of fuel. It came down in order that the navigator might get his bearings. The plane was damaged by the running sea and was unable to rise. Pounded by the waves, both lower wings were wrecked, wing pontoons were swept away, the tail was badly damaged, and the hull was severely racked and leaking badly. In order to conserve such fuel as was still in the tanks, the NC-3 crew decided to "sail" landward. It required some 48 hours for the damaged NC-3 to reach Ponta

(Continued on page 587)



The special motor unit for Army relief organizations, with trailer

The Travelling Army Auxiliary

DURING the late unpleasantness, France was full of American soldiers; it was also full of relief organizations of various sorts, working for the comfort and safety of those soldiers. The soldiers didn't stay in one spot; consequently the doughnut girls and the Y. M. C.A. secretaries and the other people engaged in making the doughboy's life as much worth living as the circumstances would permit, didn't stop very long either.

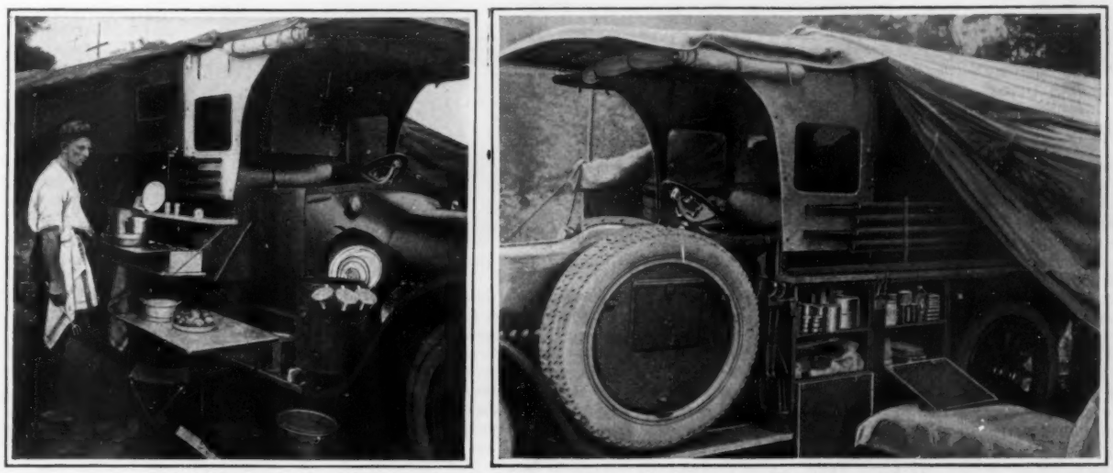
When the doughboy goes away from one spot to another, he takes a train if there is one, he takes motor truck transport if there are any trucks, but mostly he walks. But the relief organizations have to take their worldy goods with them when they move, and they have often to function while moving; so walking is out of the question. It is, accordingly, necessary for these bodies to be provided with some sort of conveyance; and the more nearly that conveyance approaches the ideal of having been designed for the express service in question, the more satisfactory it will be to its users, and the better service its users can give the army while in motion.

It need not be felt strange, therefore, that a special type of motor conveyance was designed for the purpose of moving the American relief organizations around the French landscape. It was got up by A. J. Moulton of Newport, R. I. It provides living quarters for a party of five, with cooking apparatus, provisions, and medical equipment for first aid.

The chassis of the unit in question is of 132-inch wheelbase. The roof extends over the driving seat; the body opens at the rear like a bus. Inside are seats for three. For the night, the car is halted and covered by a tent-like structure, as pictured. Four of the occupants sleep in the tent, outside the car, and the fifth in the car itself.

The furnishings of this unit include four cots, five stools and a mess table. The two-wheeled trailer carries the cots, the stools, the bedding, and bags for the personal effects of the members. Then, just above the running board of the car itself, the four-burner gasoline stove is located. This is fed from the main gas tank of the car, with a gauze strainer to prevent fires. It can be folded back, when out of use, into a compartment that accommodates at the same time a bread board, a wire broiler, a baking pan, and other cooking utensils. Pails, coffee pot, soup bowls and cups, folding frying pans, and table tools are packed in a case on the running board beside the stove. Provender is carried in canvas and oiled-silk bags. A large medical and surgical cabinet is carried, together with a writing desk with typewriter, non-spilling inkwell, etc. Individual lockers are provided for the toilet effects of the crew. Special fixtures along the inside of the car at various points accommodate shovels, an axe, a washboard, a collapsible tub, canvas buckets, brushes, a water filter, and two canteens.

The tent which surmounts the whole outfit is strapped under a cover on the top of the car while travelling. It is fastened to a ridgepole, and can be quickly pitched to cover an area 20 by 14 feet. The two rooms thus formed, each 7½ by 14, are separated by the car, but connected by a passage at the rear. There are no guy ropes or pins, but another and a better means of anchoring the tent to the pavement, when there is one, or to the ground when there is not.



Folding gas stove and dust- and water-tight supply pantries of the travelling Army Aid unit

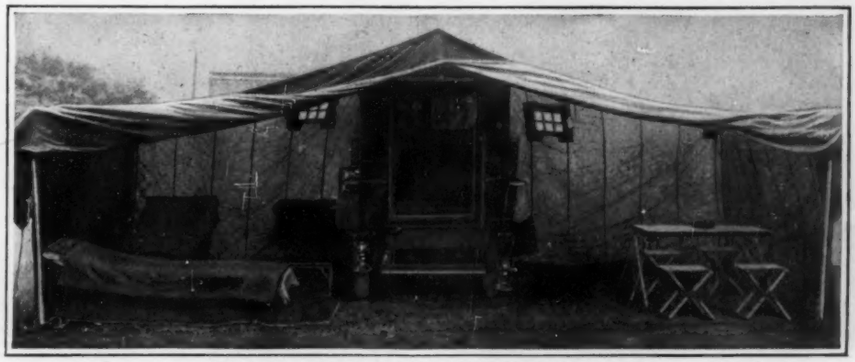
Motion Pictures and the Eyes

MOVING pictures, under favorable conditions, do not cause so much fatigue of the eyes as the same period of concentrated reading.

When there is eye discomfort there is usually some ocular defect, which should receive the attention of an eye specialist.

Under favorable conditions moving pictures causing fatigue, if continued, become unpleasant, may, if persisted in, become harmful, a condition which is greatly aggravated by fixed staring at one spot on the picture, a practice which should never be indulged in.

A review of the current literature records no permanent harm to the eyes from viewing motion pictures. The fact that about 10,000,000 more or less people enjoy moving pictures daily, with no definite reports of specific harm or injurious effect, and with but few complaints of slight inconveniences, indicates that viewing moving pictures can have no injurious effect upon the eyes.



The Army relief truck, with tent pitched for the night

A Shooting University

The Great Naval Rifle Range at Caldwell, New Jersey, where the General Public Will Be Taught by Experts How to Use the Rifle

By Capt. Edward C. Crossman, U. S. A.

Photographs by "T. E. Bunding"

A SAILOR is a person popularly supposed to have more to do with dancing the horn-pipe and splicing the main-brace than with shooting the military rifle. Even in these days of a war-educated populace, one is prone to associate the navy with depth bombs, long and swift destroyers, convoys and battleships, not with the short, brown, highly accurate rifle of Uncle Sam's land fighting forces.

Despite these ideas, our most efficient Navy, having put into being a chain of great rifle ranges the country over, and having made more of its men, numbers considered, into expert shots than did the army, now propose to stage the biggest rifle shoot the world ever saw during the months of July and August.

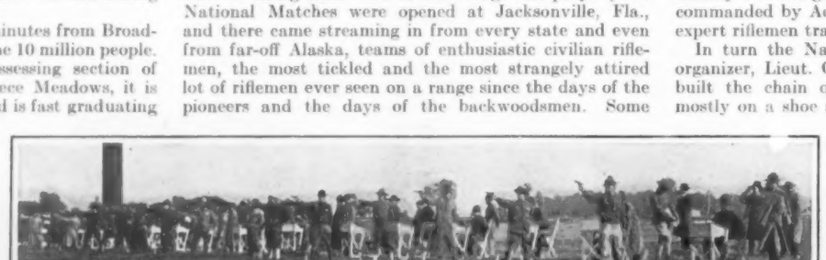
The place is Caldwell, N. J., "45 minutes from Broadway," and within an hour's ride of some 10 million people. Formerly a very wet and unprepossessing section of New Jersey, known as the Great Piece Meadows, it is now one of the Navy's rifle ranges, and is fast graduating from merely "one of them," into the greatest rifle range in the United States, as it will be by the time the opening gun is fired.

For years the National Matches have been staged by the United States Government, in coöperation with the national body of organized military riflemen, the National Rifle Association. For just as many years have the National Matches been the annual convention and the clearing house of rifle information for the enthusiasts of the country—at least those a part of our regular and militia forces.

Their weak point has been that they permitted only teams of militia from the states and regulars from the Army and Navy and Marine Corps to participate, and the plain ordinary Mister, the civilian who liked to shoot the rifle but didn't care to tie up with the militia wasn't entirely encouraged. Even then they were great affairs, with teams of 20 men from each of the states, teams representing the Infantry, Cavalry, Marine Corps, Navy and Naval Academy of our regular forces, all arguing out the final team championship in the National Team Match, and the individual matches in the preliminary shoots that came first, the National Individual of the Government and the program of the National Rifle Association. In 1913 the Pan-American and International shoots were held at Camp Perry, Ohio, in conjunction with our National Matches, with Argentina, Peru, Canada, Sweden, France and Switzerland, all sending their teams and playing in the 300-meter game in their own peculiar style.

All this time, however, the civilian rifle clubs had been growing in numbers and influence, the members plain ordinary "Misters," who were shooting the military rifles under the regulations of the government, made possible by the regulations permitting the sale and loan of Government arms to such clubs belonging to the National Rifle Association.

In 1916 two rifle enthusiasts of the Bolshevik order according to the standpatters of the game, Major Harllee of the United States Marine Corps, and Major Brookhart of the Iowa Militia got the matches open to teams of civilian riflemen from each state. With hardly a month's warning, and with the standpatters of the powers that be doing their best to discourage the project, the National Matches were opened at Jacksonville, Fla., and there came streaming in from every state and even from far-off Alaska, teams of enthusiastic civilian riflemen, the most tickled and the most strangely attired lot of riflemen ever seen on a range since the days of the pioneers and the days of the backwoodsmen. Some of them wore these cute union outersuits favored by motorcycle riders, others favored plain overalls as a shooting uniform. From Okalahoma came a real wild west team, quite like the real wild westerner, big-hatted, and one or two with notched guns. Habituated to paying a paternal Government about three cents per cartridge for the privilege of shooting their beloved Springfields, for the first time they had a taste of the militia's privilege of free ammunition, and they swarmed over the range from dawn to dark.



National Pistol Match shot in the rain, Camp Perry, 1918

Nearly 60 teams, mostly of civilians, faced the targets after the preliminary individual matches, for the team match, the event of events of the National Matches. The Marines won, the militia teams of the stronger states, Indiana, Pennsylvania, etc., won the next six places, then came a team of California civilians picked from just two civilian rifle clubs and took eighth place, defeating all other civilian teams and most of the militiamen, and beating the Marines at their own range of 1,000 yards.

Many of these civilian riflemen went into the service when we entered the war, some of them will never return from France. In 1918 the matches were again staged at Camp Perry and again the civilian teams came streaming back, this time much depleted, mostly new men, but still enthusiastic and determined to learn all there was to the game of hitting with the brown service rifle, the things, Hun or otherwise, that needed hitting.

In 1919 the powers that be, in solemn conclave, made the startling move of giving the matches to the U. S. Navy to run on a Navy range, in recognition of the great work the Navy had done in building its ranges and training its men in rifle shooting. The entire crews of the great railway 14-inch guns sent to France by our Navy, and commanded by Admiral Plunkett, were made up of the expert riflemen trained on the Navy ranges.

In turn the Navy turned over the job to the great organizer, Lieut. Col. Harllee of the Marines, who had built the chain of navy ranges through the country mostly on a shoe string so far as expense went, and by the work of Navy men alone. For the first time the enthusiastic Marine officer was given a free hand at a National Match, and that of 1919 promises to be the start of the movement to make the Americans once more a nation of riflemen. Gone is the idea that a man must "belong" to some layout or other to be allowed in the sacred purlieus of the shooting grounds.

From June to September 1st, the Caldwell range is to be a shooting university, open to any man, woman or child able to hold a rifle. The great individual and team matches come off in August when of course the tyro will either have to trot in the fast company that will be present then, or keep out, but until August, the person who never shot, is the person the Navy is hunting for. Thrashing over old straw is not the purpose of the "gobs." They see no virtue in preaching prohibition to the W. C. T. U., nor the beauties of liquor to the barkeepers, they want new material, proselytes to the game of the rifle, the pistol, and even the shotgun. Aye, even the shotgun, which is another radical departure that makes the old standpatters who'd keep away from a shoot every man not in uniform, wonder how long an outraged providence will let the world live.

For the first time it has been recognized that the shotgun, the rifle, and the pistol, differ but little, and ought to trot on the same track. The trap shooting devotee is going to have a chance to play his own game right next door to the hang-out of those queer parties who think

(Continued on page 588)

The rapid fire stage of the National Individual Match, Camp Perry, 1918

The only woman shooter in any National Match

The French Problem of Reconstruction—IV

Some of the Details of Agricultural and Industrial Reëstablishment

By C. H. Claudy, Special Correspondent of the SCIENTIFIC AMERICAN in Paris

IT is typical of rural France that almost invariably the first thing rebuilt is a grange or grain barn. Your typical French farmer doesn't live on his farm, as does his American cousin. French farmers gather in the hundreds of little towns which are so close together in France that one can almost shout from one to another. Their farms are for farming, their towns for living, and while the town, as a town, may not seem so much in American eyes, it represents to the French farmer all that his life holds of gregariousness and social intercourse. So when he begins to rebuild his farm, he thinks first of the typical farm building; when he begins to rebuild his town, then it will be time to think of the dwelling. Meanwhile he lives in his barn or a tent or a dugout or anything which is half a shelter. To aid him in finding such, the government has ordered more than 25,000 demountable wooden houses of a couple or three rooms and an outbuilding at a cost of less than $1,000 each, as well as 10,000 demountable farm buildings costing from $150 to $800 each.

Alas, once more, here was good effort lost; for several thousand of these were set up and occupied and in the path of the last German drive. But you can't discourage France by burning up a few thousand temporary shelters after what she has suffered. Any nation which can face a Rheims can face anything. People think of Rheims somehow as the city surrounding a destroyed cathedral. The cathedral is undoubtedly the world's most tragic and most wonderful ruin, from an art and a sentimental standpoint; but what of the city in which the cathedral stands? This dead and silent place, these thousands of houses, of walls and fallen stones that once were houses, these multitudes of empty staring spaces that were once homes, these poles on which are no wires, these tramway tracks on which are no cars, these cobbles over which pull no horses, this town which is now no town—and Rheims is but one of many, if the largest.

Wherever possible French troops are being used to supply labor for reconstruction work. It must not be forgotten that Peace is not yet, and be sure France is not forgetting it. But she is also not forgetting that idle troops are troops deteriorating and so General Petain's order to all military units located for several days in any one place to offer their services to the local engineer in charge of reconstruction has resulted in a good deal of otherwise lost effort being directed on the rebuilding problem.

One of the great problems, of course, is the housing and the feeding of the army of workmen who will do the rebuilding. But France has recognized this difficulty and has provided ample funds for both, as well as the spending of those funds, the purchase and the transportation of the temporary quarters, the maintenance of lines of communication with the nearest base of supplies for any district to be "invaded" by reconstruction engineers and laborers. France has not warred with a Hun for four years without learning how to support troops in the field. She now has a special service devoted entirely to the supplying and erecting of barracks wherever needed whether for refugees or for workmen.

France is a country of stone and cement, tile and brick. Wood is little used for building. It is too valuable and, besides, it burns up, and who would build a town which might burn up any time anyone became a little careless with a cigarette, *n'est ce pas?* So the government, through its Technical Service of Reconstruction, is experimenting with various building materials to see how those found in any one spot can best be utilized and has a laboratory in Paris for trying out new ideas of construction, cement mixing, brick making, building, etc. In addition it has carefully mapped France with regard to her quarries and other earth-found materials, so that there may be no useless waste of transportation in getting raw materials to the place at which they are to be used; for transportation is the "neck of the bottle," to use an American expression, in the whole building program.

There is no lack of building material; stone, brick, sand, lime, tile, cement, can be produced and are produced in most of the affected departments. What is needed is machinery and tools and coal—and transportation; and it is these things which the reconstruction authorities are trying to arrange rather than the individual details of materials. But it is a slow process with the country to be worked in a ruin, with the best men killed or wounded and the rest away under arms.

And all the while, those who work must eat. Hence the reëstablishment of agriculture is of paramount importance. Here the government helps with its tractor service although the help is short of the requirements. For instance, two years ago a million acres were released from Hun domination of which the half was cultivatable. The French tractors plowed 80,000, the French army 12,000 and the British army plowed 50,000 of these acres. Today the government owns more than 1,500 tractors of which more than half are for use in the devastated regions.

Usually of course, the French farmer does his own plowing. But usually he has his own farm beasts to plow with. What the German's didn't take, his own army did; there are few horses and mules left for rural service in France today. Twelve thousand horses a month were swallowed up in the armies. The result is that where the service of Agricultural Reconstitution is otherwise ready and anxious to put refugees back to work on their farms and to provide them with German prisoner labor, it is often estopped simply because there is no available power with which to plow; and 800 tractors can't do it all! Moreover even if some one were to present a few thousand horses to the people of France he would have to present each horse his food, also; France couldn't feed the animals if she had them. But she can feed tractors and she has ordered many more. Tractors and much farm machinery from America are what is needed. And the need is at least double that of the $8,000,000 worth contracted for by the French government so far.

Altogether, reëstablishing rural France in a productive state seems to be a vicious circle. There must be crops to feed the animals which must be fed to pull the plows, which must function before there can be crops; the crux of the matter of course is labor and that can't be had until the military situation permits. Let no American say: "Oh, devastated France will soon feed itself now it isn't overrun with Germans." Let him rather look with kindly and patient eyes at a whole people who have literally nothing left but their land and not always that, and give them his entire sympathy as they try to get something again to grow where formerly so much grew in so carefully and intensively farmed a way.

With 50 millions of dollars to its credit the Office of Industrial Reconstitution, composed half of officials and half of manufacturers, has gone bravely to work to reëstablish the shattered industries of France. How great a task this is can much better be imagined than described. It is not a case of starting up an industry

(*Continued on page 588*)

Replanting an orchard in the devastated region of France

Planting trees under direction of expert Government nurserymen

Taking out young apple trees from the Government nurseries for distribution

Testing Physical Fitness with the Camera

The Mensurgraph a New Aid to Photographic Measuring

By Robert G. Skerrett

IT is dawning upon us that the physical well-being of every American is a matter of national concern. Likewise is it essential that we have at our command facilities by which our bodily state may be checked up, verified, from time to time. This applies to those of adult years as well as to infants, and especially to our youthful citizenry during the period of adolescence. The question is, how can records be made at suitable intervals which shall satisfy the eye in arriving at external indices of development, of debility, or of retarded growth?

Science has furnished a variety of means and apparatus designed to serve these ends, but it is probably not an exaggeration to say that the art of physical appraisement is to a marked degree in a state of flux. We are literally feeling our way toward the goal of precision; and day by day it is becoming plainer that the outward aspect of the body has much to tell us if we are keen enough of vision to read aright.

The trouble up to now has been the lack of a convenient system that would give us positive data of all phases of our superficial contours and surfaces at any moment and which could again be measured during a series of prescribed observations. Sufficient nourishment or a lack of it is plainly indicated by the outward appearance of the physique. Similarly, muscular upbuilding, due to stimulating exercises, will tell its own story outwardly; and a lack of developmental balance, any deficiency that has an exterior reflex—and there are many of these—can be noted by the trained observer. But the principal difficulty to successful interpretation in the long run is a succession of records which will lend themselves to really nice comparison.

The labor laws of certain of our States specify that children between prescribed ages shall not be employed in gainful pursuits unless they have received qualifying certificates as to their fitness for any work in which they may be properly engaged. That is to say, boys and girls from 14 to 16 years old cannot join the ranks of our army of workers unless they have been found sound enough bodily to meet the stresses thus imposed upon them. The burden of establishing this status rests upon duly authorized examining officials. These officers exercise a large discretionary power; and offhand personal impression plays a conspicuous part in the decision. This invited error for which the child, first, and then the parents or the community must pay.

These youngsters, of which there are a great many thousands, are recruited annually to our industrial ranks; and that they may be a source of strength, not subsequent weakness, it is vitally essential that their taking up of life's burdens and their assumption of any particular line of effort shall be consistent with their bodily capabilities. The ordinary physical examination does not in itself suffice in many cases to place the juvenile worker in the right category as to fitness or unfitness, and a subsequent examination may be made by another official who has not any knowledge of just how the child looked when previously rejected or accepted. Thanks to the work of a New York physician, Dr. Theron W. Kilmer, this handicap to correct judgment has been very considerably reduced.

Dr. Kilmer has brought photography to his aid, and he has made it practicable to utilize the camera so that successive pictures will give correct superficial records of the external phases of the physique from all sides. Not only that, but because of the way in which the plates are made one scale of evaluation will answer for a series of prints taken at different dates—thus permitting very close comparisons of intervening bodily changes. There is nothing fundamentally new in this recourse to photography—others have used the camera before for the same purpose, but their procedure has been faulty in important respects.

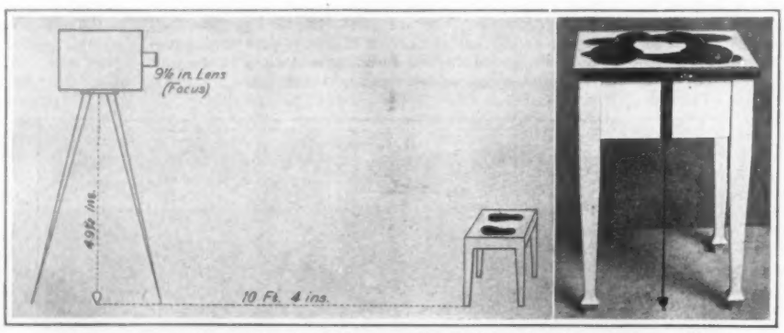
These drawbacks have been eliminated by Dr. Kilmer, and today he makes it possible to take any number of photographs at suitable intervals and to do so under circumstances that are practically identical. That is to say, the light is always the same because he uses a powerful mercury-vapor lamp. The focal distance is unvaried because the camera and the stool upon which the subject stands are just as many feet and inches apart, and the lens is at a certain height above the common floor level. Finally, the person to be pictured places his heels or toes upon limiting footprints which are painted upon the top of the stool or stand.

So far, Dr. Kilmer has introduced no feature of precision which is outstandingly novel in the realm of photographic exactness, but his method does insure of picturing the subject from time to time in the same focal plane and from the same point so that any superficial alteration will be registered in fixed proportions upon successive negatives. But how does he make it practicable to measure these contours and surfaces to a nicety and thus to evaluate properly any changes which may occur? Here is where he has introduced something decidedly new.

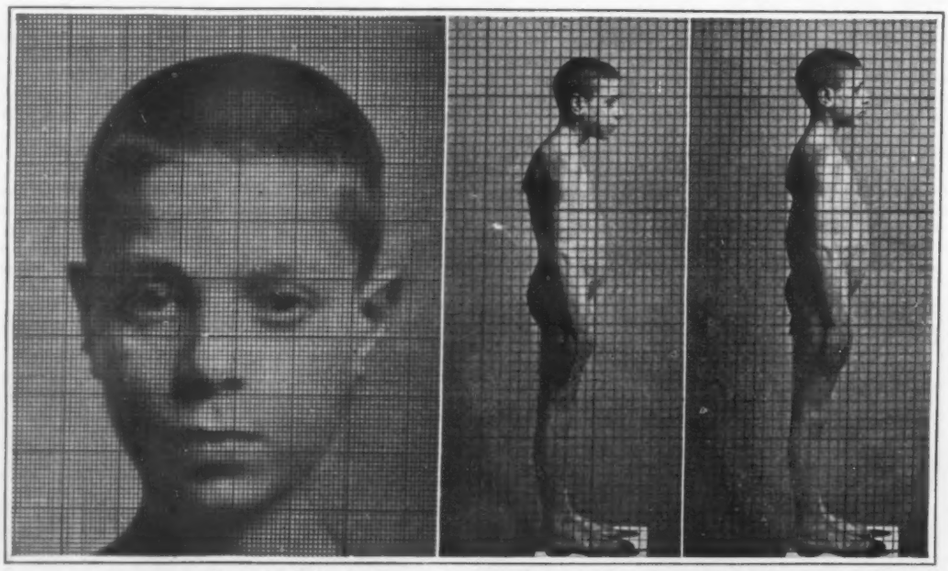
On the front of the stool are two heavy black lines—one horizontal and one vertical. These lines form a T-like registering mark at the bottom of each photograph taken. On his printing paper, before it is exposed, Dr. Kilmer stamps a similar symbol, and then lays his picture negative upon the paper so that the two T-marks—one on the paper and one on the negative—coincide. Next, the paper is exposed to light and the negative removed. Another plate, opaque and ruled in measuring squares, is substituted, and the paper is once more exposed to light. In this case, too, a T mark on the negative insures proper registering. When the doubly exposed paper is developed there is produced a picture seemingly lying beneath a screen of lines which represent feet and inches or, if so scaled, inches and fractions thereof. If the paper is developed after exposure under the figure negative only the screen, of course, is not reproduced.

In this way, Dr. Kilmer can secure a vivid photograph which shows every superficial detail of his subject and this he can examine without having his eye affected by intervening lines, or he can obtain the same picture overlaid with a series of measuring lines. The latter the inventor calls a "mensurgraph." The two photographs thus give him all of the information that he may desire for purposes of analysis; and a number of these, taken at suitable intervals, furnish a comparative record of the utmost value. The measuring scales apply with equal precision in each case, and any physical modification can be detected and given its due weight. Finally, these photographs will tell their story to any qualified observer, whether it be he or someone else who took them.

The mensurgraph method devised by Dr. Kilmer will lend itself to many useful applications. It will undoubtedly prove of importance in the military services for purposes of identification and, similarly, be an aid to police administration. The mensurgraph system will find a field of fascinating adaptation in the study of the changing modelling of the face and head from year to year, and be of particular value in watching these changes from time to time in the cases of resident children, either of domestic or foreign birth, of alien parentage. It is said that the American environment tends to blend racial features into a general native type. Dr. Kilmer has provided means by which these modifications can be recorded with illuminating precision. Further, mensurgraphing will be a great help hereafter in all X-ray work, and will tend to reduce to a minimum the errors which are all too common in reading or adjudging the revelations of the radiograph.



Arrangement of apparatus for taking mensurgraphs and enlarged view of the stool on which the patient stands



A mensurgraph of a boy's head

Development of a boy as indicated by the camera

Reclaiming Barbed Wire

THE problem of retrieving the buried and broken barbed wire on the battlefields of Flanders and Northern France is being tackled by the British War Office Salvage Committee, and a machine for the purpose has been invented and built which is thus described.

One trunk and trailer carries the whole of the plant, which can work on the most uneven ground. A stout wire rope with a number of hooks is worked by a winch. As the barbed wire is drawn up it passes through two sets of rollers, and the salved metal appears in blocks from one foot to 18 inches square, and weighing from 70 pounds to 80 pounds. For smelting it sells for about $25 a ton. The staff in charge of the scheme thinks that there are 100,000 tons that can be removed, and if that is the aggregate weight the cost of the 40 outfits said to have been ordered should be amply justified.

Some Startling Electrical Phenomena Obtained with New Form of Vacuum Tube

AN enthusiastic wireless experimenter was at work in his laboratory, when, by chance, he happened to touch the glass bulb of his vacuum-tube detector. Immediately he detected an amazing result by means of his telephone receivers. His curiosity was aroused. He wondered why he had obtained that result, and in his quest for the reason he came across a new form of vacuum tube for wireless and other purposes.

That enthusiastic wireless experimenter was none other than H. P. Donle, now the radio engineer of a large electrical company at Meriden, Conn. When he filed his patent papers at Washington, D. C., the patent examiners came back with the blunt statement that his invention was impracticable. Whereupon Mr. Donle went down before the examiners with a complete laboratory equipment, gave a demonstration before the expert electrical men of the patent office, and secured a basic patent on his invention.

Vacuum tubes, as will be recalled from the numerous descriptions of such devices and their application in these columns, are modified electric lamps used in wireless telegraphy and wireless telephony, as well as for land-line telephony. Such vacuum tubes can be used for detecting high-frequency electric currents, such as radio waves, for modifying or modulating or relaying purposes in wireless communication and in telephone work, for generating high frequency current for wireless purposes, and for amplifying or building up weak currents to powerful currents.

What Donle discovered was that it is possible to pass ionic currents through the glass walls of an incandescent lamp. In fact, by placing a metallic coating on the exterior walls of any ordinary lamp, it is possible to pass several microamperes between filament and this exterior coating, with a potential of 20 volts. In order to determine if it were possible to construct a thermionic rectifier in this manner, Donle set to work constructing several tubes containing a metallic filament and a metallic coating on the external walls. It was found entirely practical to pass currents of considerable magnitude between the incandescent filament and the external anode, the operation being about as follows:

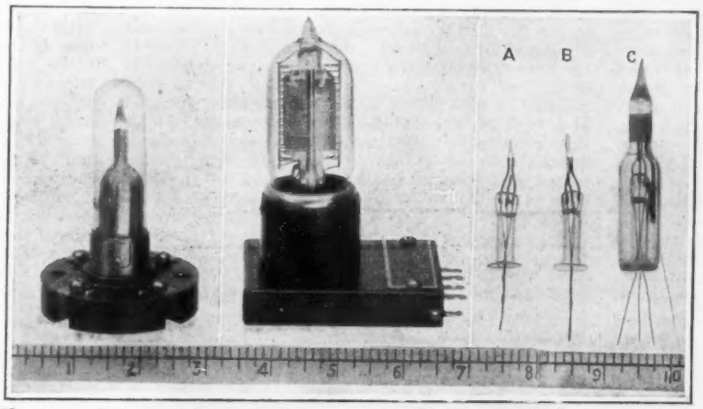
After the filament has been heated for a sufficient length of time to warm the walls of the tube, the electrons emitted from the filament strike the walls and the current is conducted through these walls in the manner described later on. This current passing through the glass increases its temperature considerably and as the conductivity is a function of the temperature the current will increase for a short time after the connection is established.

The anode current will, therefore, depend upon several factors: First, the temperature to which the glass is raised by heat from the filament; second, the anode potential, besides such factors as thickness of glass, distance from the cathode, and so on.

Thus we have glass which is heated by the radiation from the filament to a sufficiently high temperature to allow a small amount of current to pass, and by the passage of this current, the temperature is raised considerably.

The results from tests of this tube showed some very peculiar characteristics, one being that the operation depends to a large extent upon what metal is used for the anode. A series of experiments on glass samples demonstrated at once the cause of this phenomena.

Samples were prepared from a short length of tubing with an electrode fused in each end. Later many other arrangements were tried, but each gave substantially the same results as the first arrangement. These tests gave most satisfactory results. Conduction through the glass when heated was of quite a different nature from that which might have been expected. It exhibited all the characteristics that occur in conduction through an electrolyte. The three most noticeable phenomena were: 1. Polarization; 2. Increase in resistance due to the formation of [non-conducting layers on [the electrodes; 3. The deposition of the products of decomposition on the electrodes.



New type of vacuum tube at the left as compared with a standard vacuum tube in the center view. At the right are depicted the various steps in making the new tube

With like electrodes of proper material, polarization takes place in hot glass precisely the same as in an electrolytic cell containing, for instance, a diluted solution of sulphuric acid and having platinum electrodes.

The second effect, increase in resistance, was in the construction of a practical detector, of the greatest importance. This effect depends entirely upon the material of the electrodes; for example, in a sample of lime glass with nickel electrodes, heated to say 400 degrees C., and an applied E. M. F. of 20 volts, when the circuit was closed the current might amount to five milliamperes, but in five seconds this current decreased to less than one-tenth of one per cent of its initial value. With silver electrodes this effect is almost entirely absent; and with a tube having one electrode of silver and one of

(Continued on page 589)

A Successful Type of Anti-Noise Transmitter and Loud-Speaking Telephone

TWO years ago it was the common belief that telephony aboard an airplane was impossible. How could one talk into a transmitter with one or more unmuffled engines roaring but a few feet away? How could one hear with the thundering engines and rush of air and the many other sounds incidental to airplane travel? Frankly, the problem seemed almost impossible of solution.

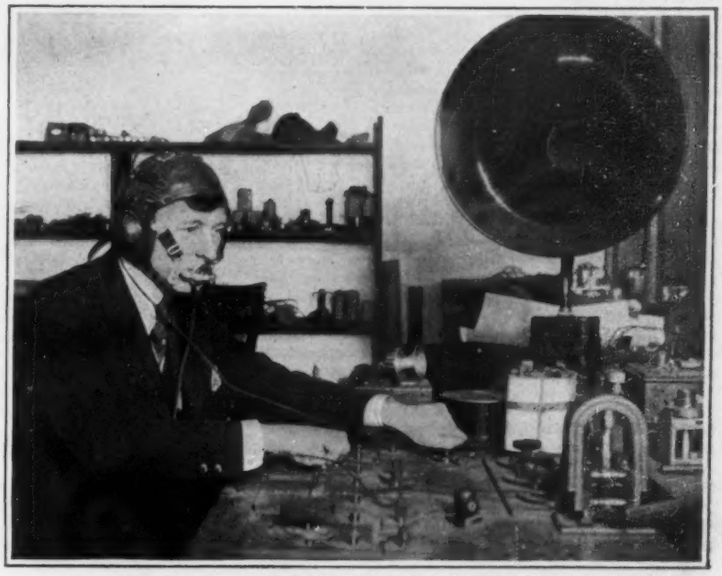
At first, when the call for telephone apparatus for airplane use became imperative not only for intercommunication between members of the crew but for wireless telephony, inventors set to work on various schemes for barring out engine and other sounds, while confining the voice to a small chamber containing the telephone transmitter. Such schemes, however, were not successful. The roar of the engines still persisted despite attempts at sound-proof mouthpieces. One scheme which has been worked out to a relative success consists of a telephone transmitter provided with a mouthpiece having three small holes The action of this transmitter is based on the fact that the direct impact of the speaker's voice passes through the small holes and operates the diaphragm, while the sound waves of the roar of the engine cannot pass through the holes because the sound waves are not in line with them. However, when transmitters of that design have been applied to multi-engined planes such as the NC Naval boats, they have proved unsatisfactory; and in the long run they have only proved satisfactory on smaller single-engined planes.

It has remained for two inventors, E. S. Pridham and P. L. Jensen of San Francisco, Cal., to develop a really successful and universally practical transmitter for airplane use. At first these inventors, like most others at work on the problem, attempted to muffle their transmitters so as to exclude engine noise. They made most of their experiments in the testing room of an airplane engine manufacturer, where dozens of engines were being tested at one time. Then one day the inventors decided on a daring move; they gave up the idea of muffling the transmitter and, instead, made it absolutely open or stripped of casings of all kinds. They permitted all noises to come in contact with the transmitter—at the front and at the back, all round, so as to allow the sound waves to act equally free on both sides of the diaphragm. The result has been the balancing of all extraneous sounds since the waves strike the diaphragm with equal force on both sides, hence neutralizing each other; while the voice waves strike the diaphragm on one side only, temporarily destroying this balance and therefore affecting the circuit.

The latest form of anti-noise transmitter designed by Pridham and Jensen consists of a diaphragm and a transmitter button. The button is set at an angle with

(Continued on page 590)

How the anti-noise transmitter is applied to regular telephony. The receiver mechanism, in this case, is located in the base of the hand set



How the aviator wears the anti-noise transmitter, and the special loud-speaking telephone which operates on a new principle

The Heavens in June, 1919

New Light on the Formation of the Star Systems and the Nebulae

By Prof. Henry Norris Russell, Ph.D.

IT is not always to the achievements of the observer that the astronomer points when he is asked to point out the most interesting bits of recent work. At times it is the physicist whose deductions from some mass of already known facts appeal most keenly; again it may be the most severely theoretical work of the mathematician which stands out in prominence.

A fine example of the latter sort is found in some recent papers by the distinguished English mathematician, Jeans, one of the leaders of that new school of investigators who have in late years come out of Cambridge University to score such notable successes in the attack upon the greater problems of mathematical and astronomical physics.

The subject of Mr. Jeans' present researches is one of obvious astronomical importance. What will happen to a large rotating mass of compressible gas if it is left to settle into equilibrium under its own attraction, and then to shrink slowly as it loses heat by radiation?

This is no new problem; indeed it is the fundamental thought of the old nebular hypothesis of Kant and Laplace, and has fascinated men's minds ever since. Great indeed is the volume of speculative writing on the problem, and many have been the assumptions made regarding the probable behavior of such a rotating mass. But if, instead of unproved assumptions, we seek a well-considered theory, based upon rigorous mathematical deductions from clearly stated postulates, the available literature shrinks at once to small proportions; for the mathematical treatment of the problem is exceedingly difficult, and even now it remains only partially solved. As is usual in such cases, the first line of attack was to study the solution of a similar but much simpler problem—namely, the case in which the rotating mass was composed of some hypothetical homogeneous and incompressible fluid. This removed a host of intricate complications; even so, the mathematical discussion was very far from simple.

How a Whirling Mass of Gas Behaves

This problem, however, has now been substantially solved by the successive efforts of a long series of distinguished investigators, of whom Jeans himself is the last. Suppose that we start with a mass of low density, in slow rotation; its form will be like that of the earth, nearly spherical, but flattened at the poles. If now the material contracts and grows denser, the mass will rotate more and more rapidly as it shrinks, and its form will become more and more flattened—the equator remaining an exact circle, but a section through the poles being of elliptical outline. Finally, when the polar diameter is a little less than 60 per cent of the equatorial, this figure becomes of unstable equilibrium. The slightest disturbance will cause it to change more and more in shape; but it can be shown that the final result would be its settling down into a stable figure of another sort, an ellipsoid in which not only the sections through the poles, but also those through the equator, would be ellipses. In mathematical jargon, the thing has ceased to be an ellipsoid *of revolution*. Further shrinkage will cause this ellipsoid to become more and more elongated, until in time the body is shaped almost like a cigar—about three times as long as broad, and rotating about an axis at right angles to its greatest length. At this point the equilibrium once more becomes unstable; but this time there is no other stable series of figures into which the body can change by any series of gradual modifications.

What happens instead is that a furrow forms around the cigar-shaped mass, nearer one end than the other, and rapidly deepens. At this point exact mathematical analysis becomes too complicated to carry further. But there is no doubt that the mass separates into two parts, one a little larger than the other, each of which settles down to an ellipsoidal form, and begins to contract on its own account. The resulting system would be very like a double star. Further contraction would cause the two components to rotate faster and faster and perhaps to break up into close pairs (unless the influence of the friction of the tides which each mass would raise in the other were sufficient to prevent such repetition of the old story).

So, ultimately, we should have many double systems (where tidal action had prevented a second separation), and other multiple systems where one or both of the components of the original pair had split up into closer pairs, in much more rapid revolution.

Now this final theoretical picture is a remarkably good likeness of the actual double and multiple stars. Numerical tests can be applied to see whether the similarity is really close; for from the theory it follows that triple or multiple systems should consist of close pairs, attended at a relatively great distance by other single stars or close pairs. The present writer has shown that this is actually the case. There are many instances in which a second separation has taken place, and a few in which some of the bodies formed by the second fission have themselves split for a third time into still narrower pairs.

But all this discussion, until recently, rested on a very unsatisfactory theoretical basis; for the theoretical work dealt with the properties of masses of "incompressible fluid" and the actual stars are composed of highly compressible gas, and are certainly not homogeneous, but are greatly condensed toward their centers.

Jean's recent work has made the first successful attack upon the far harder problem of following the behavior of a mass of compressible gas. The analytical work is naturally of a very advanced order, and only the general results are capable of interpretation in ordinary language. Strictly speaking, they fall short of absolute proof; for they proceed through the calculation of the principal terms of an infinite series, and the value of the "remainder," consisting of the infinite succession of ever-smaller terms which have not been calculated, can only be estimated. Enough has been done, however, to give a very good idea indeed of the nature of the solution.

Applying the Theory to the Stars

It is found that if the gas is rather difficultly compressible, as is the case with most gases when they are compressed to a density something like a quarter of that of water, the mass of compressible material will behave much like an incompressible mass, and will change from a spheroidal to an ellipsoidal state, and then presumably separate into two parts, as outlined above. But if the density of the gas is low and it is highly compressible, something quite different happens. As the shrinking mass rotates faster and faster, it assumes a form much like that of a thick double-convex lens, rotating about its axis of symmetry. The edge of the lens is at first rounded, but it finally becomes sharp, and, after this stage is reached, matter is ejected all around the equator, in a manner strikingly similar to that imagined by Laplace a century ago.

But the matter so ejected will not gather together into rings as Laplace supposed. If there were nothing else in the universe, but the single mass of gas, it would indeed form a thin sheet in the equatorial plane. But all the stars and nebulae in the heavens will be attracting an actual mass; and, as Jeans has shown, their combined attraction will produce, as it were, two points of "high-tide" at opposite sides of the equator, at which the streaming out of the escaping material will be localized. It will travel into space, therefore, not in a continuous sheet, but in the form of two streams starting on opposite sides of the nucleus, and running outward and around it in the direction of the rotation. In other words, there will be a lens-shaped nucleus surrounded by two outwardly moving spiral streams—and here again the theoretical picture is an actual likeness of something that actually exists in the heavens above—the spiral nebulae.

Jeans has followed up this most suggestive lead by showing that the outgoing streams of matter from a rotating body of the size of the sun would diffuse away into space, but that the vaster streams escaping from a mass thousands of times as great would probably break up into separate portions, each of which would condense into a body comparable in mass with the sun. Now there is good reason to believe that the masses of the spiral nebulae are very great; so once more theory and fact seem to go hand in hand.

The conception of a spiral nebula which Jeans has thus made possible may justly be called magnificent. The central nucleus is a huge, lens-shaped mass of gas, containing within itself matter enough to form many thousands of systems like ours. As it rotates, the centrifugal force at its outer edge almost exactly balances the attraction of the main mass. At two opposite points of the boundary the gaseous material escapes, and flows out in enormous spiral streams. At first it is of exceedingly low density, but gradually it condenses into separate nuclei, and these shrink into stars.

The boldest astronomer might well have hesitated to commit himself to so extraordinary a sequence of ideas without the steadying consciousness of a definite mathematical foundation on which to rest; but this time the process was reversed—mathematical study of a quite different problem laid the foundation, and once this was effected, the brilliant theory almost raised itself.

At 12 o'clock: June 7.
At 11½ o'clock: June 14.
At 11 o'clock: June 22.

At 10 o'clock: July 7.
At 9½ o'clock: July 14.
At 9 o'clock: July 22.

At 10½ o'clock: June 30.

The hours given are in summer clock time.

NIGHT SKY: JUNE AND JULY

The Heavens

As our map shows, the Milky Way stretches across the eastern sky in a great arch, from North to South. Following its course, we find Cassiopeia low in the Northeast, then Cepheus, next Cygnus, with Lyra a little above, then Aquila, then the superb and intricate clouds and masses of stars in Ophiuchus and Sagittarius, and last the constellations Sagittarius and Scorpio, low in the South. Hercules and Bootes are East and West of the zenith, and Corona is almost overhead. Draco and Ursa Minor are above the pole, and Ursa Major is high in the Northwest. Leo and Virgo, in the West, are the remaining conspicuous constellations.

The Planets

Mercury is in conjunction with the sun on the 11th, and though he is nominally a morning star before that date and an evening star afterward, he is practically invisible except at the extreme end of the month, when he sets at 9.50 P. M. summer time. On the 27th, he is in conjunction with Jupiter, being 1 degree 38 minutes north of the latter.

Venus is an evening star, and is unusually well placed for observation. She is in Gemini and Cancer, far north

(Continued on page 590)

A Stethoscope for the Earth

The Geophone, Invented for War Service, but Which Gives Promise of Great Industrial Value

By Our Washington Correspondent

THE arts of peace are almost all convertible to the arts of war; much more seldom is it that a strictly war invention finds even greater uses in peace. But sometimes the invention brought into being by war's necessities has a wide application when war ceases and such seems to be the case with the geophone, a listening instrument invented by the French, for the purpose of the more readily detecting enemy sapping and underground mining operations and for locating enemy artillery.

The microphone we have always with us when it comes to devising any apparatus for the detecting of faint sounds. But the French engineers who designed the geophone began from another angle, for the very good reason that not all vibration translates itself as sound, and microphone tests show there is a distinct limit well within the danger zone when faint sounds of pick and shovel are not detected by the electrical apparatus.

The geophone has nothing electrical about it; it is mechanical entirely and operates upon the principle of the seismograph, the instrument used for detecting and recording earthquakes. As the reader undoubtedly knows, the seismographic principle is that of a so-called steady mass which remains practically motionless because of its inertia, when the earth moves beneath it in seismic disturbrances. Having thus a point in motion (the earth), and a point stationary (the steady mass) the seismologist is able by means of a chronograph drum and pen to record the amplitude and duration of earth vibrations.

The geophone consists of an iron ring about three and a half inches in diameter, within the center of which is suspended a lead disk, fastened by a single bolt through two mica disks, one of which covers the top and the other the bottom of the ring. Two brass cap pieces are fastened with bolts to the iron ring to hold the mica disks in place, the top one having an opening in its center to which is fastened a rubber tube, leading to a stethoscopic ear piece.

The apparatus, then, consists of a lead weight suspended between two mica disks cutting across a small air-tight box. If the instrument is placed on the ground and there is any pounding or digging in the vicinity, energy is transmitted as wave motion through the earth, and earth-waves shake the geophone case. The lead weight, on account of its mass and because it is suspended between the mica disks, remains comparatively motionless. There is then a relative motion between the instrument case and the lead weight and a compression and rarefaction of the air in the instrument takes place. Since the rubber tube leading to the stethoscopic ear piece is connected with this space in the geophone, this rarefaction and compression is carried to the ear when it makes itself manifest as sound. The diagram will make the construction clear and the photographs show the method of using the device.

It should be noted that it is not necessary for sound, meaning vibrations of such range as comes within the compass of the human ear, to reach the geophone in order that sound may be heard in the ear pieces. The wave motion communicated through the earth may be as absolutely soundless as is the electric current which serves to transmit a telephone conversation, and yet be transformed to sound in the air-chamber of the geophone, much as the electrical energy in the telephone circuit is made manifest in the receiver as sound, though no actual sound passes over the wires.

The geophone, which has been developed by army engineers and is now in use by the Bureau of Mines in connection with mine rescue work, has a number of peculiarities which particularly fit it for the work it has to do. One of these is the readiness with which the ear recognizes which of two sounds in two geophones reaches the auditory nerves first. Two geophones are used, one for each ear. The impression is that the sound in one ear is louder than the other; that it is not actual loudness, however, is proved by the readiness with which an operator slightly deaf in one ear is able to orient sounds. In using two geophones, it is merely necessary to move them about against the wall through which the vibrations are coming, until a point is found where the sounds have

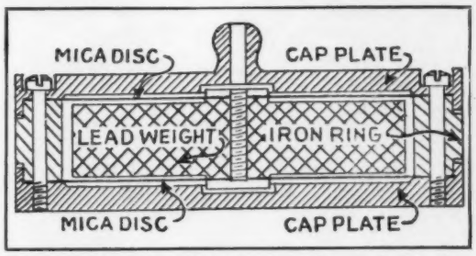


Diagram of geophone showing the scheme of operation

the same intensity to both ears. The direction in which the sound comes, then, will be perpendicular to a line connecting the two instruments. Whether the sound be in front of or behind the observer is a matter for further observation, but is readily determined.

What such an instrument may mean in mine rescue work can be best appreciated by those who have attempted to locate entombed miners by other means. Knowing where to dig and in what direction is often three-fourths of the rescue campaign.

The instrument is extremely sensitive, not only to vibration, but to variations in the vibrations, so that it is very easy to detect the source of the sound, whether it is pick, hammer, explosion, fire, running water or whatever the cause of the earth-waves may be. An experiment was made by a Bureau of Mines engineer who had never used the instrument before; after listening to sounds caused by 12 different mining and carpentering operations he was able, with ease, correctly to name nine of them and accurately to describe the other three sounds although they were too unfamiliar to him to allow him to name them.

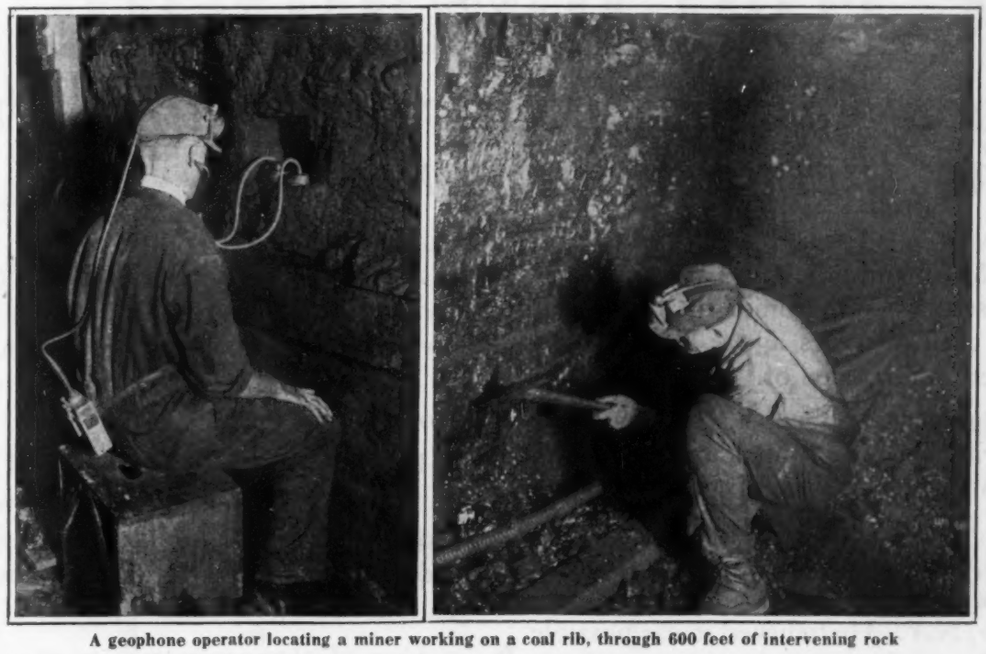
While not unlimited the geophone is not narrow in its range; a pick striking into bituminous coal is easily heard through 900 feet of intervening coal and earth, and a sledge pounding can be heard 1150 feet with sufficient clearness to enable the direction to be accurately noted. The explosion of an ounce of dynamite transmitted wave energy, translated as sound in the geophone, for more than two thousand feet.

Another surprising feature of the geophone is that the presence of intervening rooms, galleries and entries seem to have little effect on the resulting sound. Apparently the earth waves are transmitted in all directions and are picked up by the geophone without much regard to the continuity of material between it and the source of the vibration. This is a very important factor in considering the instrument as an aid in mine rescue work.

While the geophone will locate the direction of a scource of wave motions with great accuracy, it cannot, of itself, determine distance. There are two ways of doing this, one by expertness of the operator, who is able after a little practice to determine with reasonable accuracy how far distant a recognizable sound may be produced, providing he knows the general character of the earth through which the vibration is coming; the other method, of course, is to use two sets of geophones and locate the sound source from two directions. Having two angles and a known base the distance is then a mere matter of arithmetic.

Another phenomenon of the geophone is the readiness with which it picks up sounds through the mine cover, although this readiness is largely influenced by the state of the air outside, any great amount of breeze seriously interfering with its action. A man pounding with a sledge can be located two or three hundred feet under the surface, from the surface, and at the experimental mine in Bruceton, Pa., a miner has repeatedly been located within 50 feet, through 150 feet of cover.

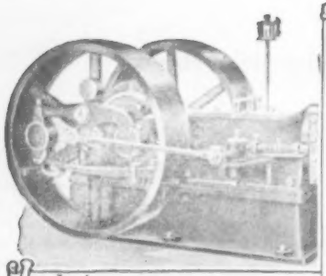
The geophone is by no means limited to rescue work in mining operations. In metal mining, experiments are proving that it can frequently take the place of difficult and expensive surveys designed to bring two borings to a meeting. This is not theory, but the result of an actual experience, in which Bureau of Mines engineers located the trouble in a metal mine where a drift and raise, supposed to meet, had missed. Observations were made in the drift, of pounding, in the raise, and then observations were made in the raise, of poundings in the drift. The engineers concluded that the two had missed by about six feet, and named the direction of each from the other. Not willing to trust the new instrument, the mine operators insisted on a survey, but when it was made the result was as already determined by the geophone. The instrument is particularly useful in direction determination in a metal mine, rather than a coal mine, because metal bearing rock transmits the vibrations in a more clear-cut manner than coal. This is probably because there is some reverberation to the sound from a blow on wood, while on the stone the sound is clean-cut.



A geophone operator locating a miner working on a coal rib, through 600 feet of intervening rock

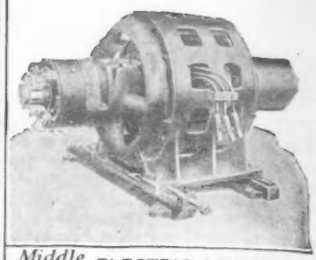
Observations were made in another raise which was being driven up, about six or eight feet distant from a drift. Observations were made in the drift, of the sound from the drill in the raise, and a point located on the side of the drift behind which the drill in the raise was apparently operating. The survey mark was two and one-half feet to the right of this mark. A drill set up and operated at the survey mark did *not* break through into the raise, but a hole drilled at the point in the drift located by the geophones reached the raise and proved the geophone observation to have been correct within a few inches.

(Continued on page 591)



Late 70'S STATIONARY STEAM ENGINE

1877 George B. Selden's First Automobile



Middle 80'S ELECTRIC MOTOR & GENERATOR

Six Great Inventions

How Gargoyle Lubricants cleared the way for their development

SPERM oil and tallow. Lard and suet. These marked the limits of lubricating less than 60 years ago. Present high speeds were undreamed of.

The engineer swabbed his slow-moving pistons with a brush dipped in tallow. A ridiculously bulky mass of metal was required to produce small horse-power.

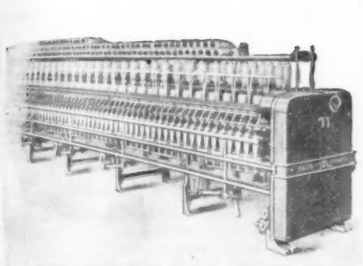
In 1866, Hiram B. Everest erected a small still in the back yard of Mathew Ewing in Rochester, N.Y. He believed it was possible to distil the whole body of crude petroleum into kerosene, but found it was impossible to escape a residue which had no commercial use or value.

A study of that residue marked the beginning of the Vacuum Oil Company. Mr. Everest, as president of the Company, lived to see Gargoyle Lubricants known the world over.

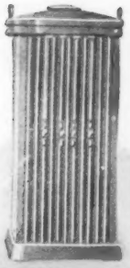
For step by step, Gargoyle Lubricants replaced lard, suet, sperm oil and tallow. Today the red Gargoyle is recognized the world over as the symbol of scientific lubrication.

One of the greatest sources of pride to Vacuum Oil men is the part their company has played in quickening the development of useful inventions. Six instances follow.

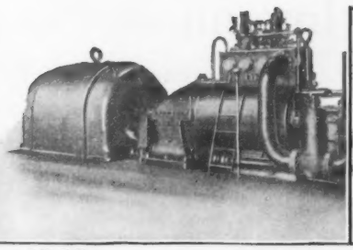
VACUUM OIL COMPANY *Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world* NEW YORK, U.S.A.



1889 HIGH SPEED SPINDLE



Early 90's ELECTRIC TRANSFORMER



1902 1905 STEAM TURBINE

Stationary Steam Engine Lubrication (Late 70's)

PRIOR to the production of Gargoyle Cylinder Oil 600-W stationary steam engines were lubricated with tallow.

Gargoyle Cylinder Oil 600-W was the first successful petroleum lubricant used for steam engines. Its success was so marked that a large number of imitations soon appeared. But to this day no other cylinder oil is so well adapted to the wide range of steam engine conditions as Gargoyle Cylinder Oil 600-W.

Automobile Engine Lubrication (1877)

IN 1872, Mr. George B. Selden set out to invent a mechanically propelled wagon.

In 1877, with high heart he looked upon his finished engine. Then came a setback. He found that none of the animal or vegetable lubricants then in use would give adequate service on this new kind of internal-combustion engine. So great was the inefficiency of these oils that Mr. Selden practically gave up the idea of perfecting his engine for road service.

Later in the year he learned that the Vacuum Oil Company had produced a new, clear petroleum lubricating oil. He secured a few gallons. The turning point was realized. The problems of oil decomposition and highly offensive exhaust smoke were wiped out. The new oil lubricated his engine with high efficiency. He went ahead with his work.

Mr. Selden paid that oil the following tribute:

"It is beyond doubt that the Vacuum Oil Company was the first to make a suitable pure mineral oil that would lubricate a gasoline automobile, and I was the first one to make use of it."

Today Gargoyle Mobiloils supply scientifically-correct lubrication for each make and model of automobile, motor-truck, farm tractor, motorcycle and motor-boat.

Electric Generator and Motor Lubrication (Middle 80's)

IN the middle 80's new designs in Electric Generators and Motors introduced the new speed of 1000 revolutions per minute. This brought up a fresh lubricating problem. The Vacuum Oil Company turned to meet it. Gargoyle Arctic Engine Oil was produced to meet this lubricating need. Although other oil companies later offered oil of almost identical specifications at half the price, users found Gargoyle Arctic Engine Oil far more economical.

High-Speed Spindle Lubrication (1889)

IN the early 80's a relatively thin oil was used for spindle lubrication. The Vacuum Oil Company's engineers, however, believed that the oil was unnecessarily heavy for the work—resulting in an unnecessary waste of power. After a period of experimentation the Vacuum Oil Company produced Gargoyle spindle oils. Textile mills reported a marked saving in coal bills on changing to these lubricants—frequently as great as 40%.

Electric Transformers (Early 90's)

THE first transformers handled currents of from 2000 to 3000 volts. The higher the voltage the greater the heat. A petroleum product is here used as an insulating and cooling medium.

This new problem was met when the Vacuum Oil Company, working with the electrical companies, produced for them distinctive grades of Transformer Oils specially adapted for their appliances. Manufacturers were thus enabled to raise the early voltages higher and higher. Today 90,000 volts are possible.

Steam Turbines (1902-1905)

STEAM turbines presented two new lubricating problems: (1) They operated at speeds of 1800 to 3600 r. p. m. (2) Water tended to get into the system which, when churned with the oil, formed a sludge. This sludge would often choke the oil pipes.

The turbine problem centered about the production of lubricating oil which would not sludge and which would readily separate from water. After extensive research and experiment, this problem was met through the production by the Vacuum Oil Company of three grades of Gargoyle D. T. E. Oils.

A VAST share of the progress of mechanical invention during the past half century would have been impossible without marked progress in the science of lubrication. The contributions of the Vacuum Oil Company during the past 50 years are generously appreciated by power engineers the world over.

The future of invention will doubtless present fresh problems in lubrication. The Vacuum Oil Company pledges its resources to meet these requirements as they arise.

The work must go on.

GARGOYLE

Lubricants

A grade for each type of service

Domestic Branches:

New York, Boston, Philadelphia, Pittsburgh, Detroit, Chicago, Minneapolis, Indianapolis, Kansas City, Kan., Des Moines

Correct
AUTOMOBILE LUBRICATION

GARGOYLE

Mobiloils

A grade for each type of motor

Gargoyle Mobiloils for engine lubrication are:

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil Arctic

The Chart below indicates the grade recommended by the Vacuum Oil Company's Board of Engineers. The recommendations cover all models of both passenger and commercial vehicles unless otherwise noted. If your car is not listed in this partial Chart, send for booklet "Correct Lubrication" which lists the correct grades for *all* cars.

AUTOMOBILES	1919 Models		1918 Models		1917 Models		1916 Models		1915 Models	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Apperson			A	A	Arc	Arc	Arc	Arc	Arc	Arc
Apperson (8 cyl.)	A	A	A	A	A	A	A	A		
Auburn (4 cyl.)							A	Arc	A	Arc
Auburn (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Auburn (6-88)					A	Arc	A	Arc		
" (6-39)(Teetor-H)			A	Arc						
Autocar (2 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Briscoe	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)							A	A		
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cadillac (8 cyl.)	A	A	A	A	A	A	A	A	A	Arc
Case	Arc	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
Chalmers			A	A			Arc	Arc	Arc	Arc
" (6-40)							A	Arc		
" (6-50)	A	A			A	A	A	A		
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A				
" (F.A.)	A	Arc	A	Arc						
Cole							Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A	A	A
Cunningham									Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Dart	Arc	Arc	Arc	Arc	A	Arc	A	Arc	Arc	Arc
" (Model C)					A	Arc	A	Arc	A	Arc
" (2 and 3½ ton)	A	A	A	A						
Dodge Brothers	A	Arc	A	Arc	A	Arc	A	Arc	E	E
Dort	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Federal	Arc	Arc	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. 5-X)			A	A	A	A				
Federal (special)			Arc	Arc						
Fiat			B	A	B	A	B	A	B	A
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	A
Grant	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
" Con't	Arc	Arc								
" " (Model 12)	A	Arc								
Haynes	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A		
Hollier (6 cyl.)	Arc	Arc	A	Arc	A	Arc				
" (8 cyl.)	A	A	A	A	A	A	A	A	A	A
Hudson							Arc	Arc	Arc	Arc
" Super Six	A	Arc	A	Arc	A	Arc	A	A		
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Jordan	Arc	Arc	Arc	Arc	Arc	Arc				
Kelly Springfield	A	A	A	A	A	A	A	A	A	A
King									A	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A	Arc	Arc
" Commercial			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Kissel Kar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" " (Model 48)							A	A	A	A
" " (12 cyl.)			A	A	A	A				
Lexington	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Liberty	Arc	Arc	Arc	Arc	Arc	Arc				
Lippard Stewart			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. M)					A	Arc	A	Arc		
" " (Mod. MW)					A	Arc				
Locomobile	A	E	A	E	E	E	E	E	E	E
McFarlan			A	Arc	A	Arc	A	A	Arc	Arc
Madison			A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)					A	A	A	A		
Marmon	A	A	A	A	A	A	A	A	A	Arc
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	A	A	A	A	Arc
" (22-70)									Arc	Arc
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)							A	A		
Moline-Knight	B	A	B	A	A	A	A	A	A	A
Monroe			A	Arc	A	Arc	E	E	A	Arc
" (Mod. M4)			A	A	A	A				
" (Mod. S)	A	A								
Moon			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Nash	A	Arc	A	Arc						
" (Mod. 671)			A	A						
" (Quad)	A	A	A	A						
National	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
" (12 cyl.)	A	A	A	A	A	A				
Nelson	A	A	A	A						
Oakland	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)					A	A				
Oldsmobile (4 cyl.)	A	Arc					Arc	Arc	Arc	Arc
" (6 cyl.)	A	A	A	A	Arc	Arc			Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Overland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Owen Magnetic	A	A	A	Arc	A	Arc	A	Arc	A	Arc
" " (Mod. M25)			Arc	Arc	Arc	Arc				
Packard									A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A		
" Commercial	A	A	A	A	A	A	A	A	A	A
Paige (4 cyl.)									A	Arc
" (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6-50)							A	Arc	A	Arc
" (6-38-39)			A	Arc						
" (6-40)	A	Arc	A	Arc						
Paige (Con't)	Arc	Arc	Arc	Arc						
Paterson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Peerless			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Pierce Arrow	A	A	A	A	A	A	A	A	A	Arc
" " Con't	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	A	Arc	A	Arc
Regal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
(8 cyl.)							A	A	Arc	Arc
Renault (French)							A	Arc	A	Arc
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Riker	A	E	A	E	E	E				
Saxon	E	E	E	E	E	E	E	E	E	E
Selden	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (3½ ton)					A	Arc				
Simplex Crane			A	A	A	A	A	A	Arc	Arc
Stearns-Knight	B	A	B	A	A	A	B	A	B	A
Studebaker	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Velie (4 cyl.)									A	Arc
" (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (2 & 3½ ton)	Arc	Arc	Arc	Arc						
" (¾ ton)	A	Arc	A	Arc						
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Saxum Valve)	A	A	A	A	A	A				
White (3 ton)	A	A	Arc	Arc						
Willys-Knight	B	A	B	A	A	A	B	A	B	A
Willys Six	Arc	Arc	Arc	Arc	Arc	Arc				
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

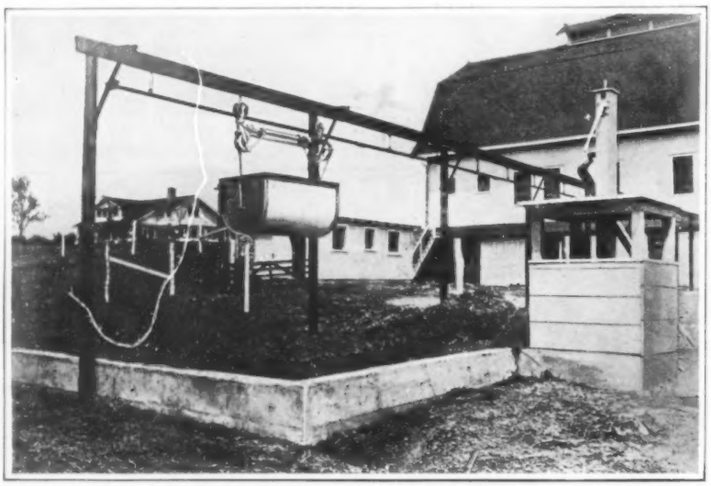
VACUUM OIL COMPANY *Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world* NEW YORK, U.S.A.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

A Concrete Pit that Saves Money for the Farmer

WITH the price of fertilizer going up the farmer is turning to the stable waste on his farm and finds it a valuable asset. Formerly little care was taken to get the best results from this fertilizer. When thrown from the stable it has been allowed to deteriorate, losing a great deal of the plant food contained in it. But the modern farmer finds it worth while to go to the small expense of putting concrete pits on his place to hold this manure from the stable. Formerly one of the most valuable parts of the fertilizer was lost entirely and that was the liquids. A cistern is provided into which the liquids run and are there preserved for use. As a labor-saving device this farmer has a manure conveyor which runs out on a trolley to the pit and can be dumped wherever wished by the man in the stable. This saves much time which is a large factor on the farm.



A concrete manure pit that prevents an important farm waste

First Aid to the British Motorists

IT has remained for the Automobile Association of England to establish a system of first-aid stations for its members along important routes. In fact, with this system installed motoring is bound to become a more or less tame affair, which is more to the liking of the motorists of the old world.

The first-aid system makes use of a large number of telephone stations installed along the most important roads. The motorist who comes to grief has but to go to the nearest telephone station and call for aid, provided he is a member of the Automobile Association of England. The nearest first-aid station responds by means of motorcycles with side cars, which carry the necessary tools and equipment for making all the necessary repairs. A stretcher is also included in the equipment, in the event that the accident is one of personal injury; and by strapping the injured motorist and stretcher on top of the side car it becomes possible to make good time to the nearest hospital.

Copyright, Underwood & Underwood

First-aid-to-motorist motorcycle and side car under way

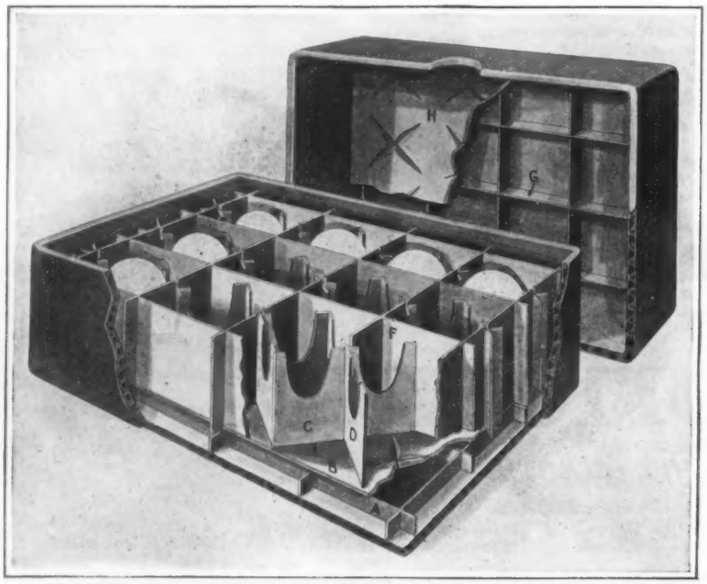
Photo International Film Service

England's first-aid-to-motorist men taking care of the injured due to an automobile accident

An Egg-Mailing Case That Does Not Have to Be Handled With Care

THERE has been no end to the boxes and crates and packages designed for the transportation of eggs by express or parcel post. Some of them have proved reasonably effective in actual use; but for the greater part the eggs have not had the proper protection when subjected to the roughest handling.

It has remained for J. M. Richens of Jacksonville, Fla., to design what appears to be a satisfactory crate for the transportation of eggs by express or parcel post. As will be noted in the accompanying drawing, which is more or less self-explanatory, the crate consists of a corrugated cardboard box and a protective structure of cardboard strips. Starting with the bottom, the crate makes use of a number of crossed strips of cardboard, shown at *A*. Resting on this framework of crossed strips is a piece of cardboard, *B*, cut with a large number of crossed slits, the intersection of each pair of slits being above the center of the lattice-work squares. Then comes the arrangement that forms the 12 egg compartments, shaped as shown at *C* and *D*, surmounted by another piece of cardboard with crossed slits, *H*, and some more lattice-work, *G*, in the top cover. The cardboard with crossed slits represents a remarkably resilient surface to the end of the egg, while the entire protective arrangement is quite capable of absorbing all shocks.



This form of crate is said to be available for use in mailing eggs without the least danger of breaking them

Recent Patent Decisions

THE appellant, David F. Moore, sued the United States in the Court of Claims to recover compensation for the use, without license or lawful right, of a tool, which was patented and of which he was the owner. The plaintiff alleges that from 1903 to 1914 inclusive, he invented the tool in question, which was adapted to be used as a reefing iron on the decks, sides and bottoms of vessels where wood caulking is done—that he entered the employment of the Government as a woodcaulker in a navy yard in March, 1913, and continued therein until July, 1914—that during the month of May, 1914, Mr. Moore completed his invention—and that during the hours of his employment by the Government he did not do any work upon his invention, but that such work as was performed upon it subsequent to March, 1913, when he entered the government employ, was performed at his home. For the extensive use which the Government had made of the tool he prayed for compensation which had been demanded and refused. It is held that where the device was discovered or invented by a government employee during the time of his employment or service, applies where he completed his invention during such time, though his work thereon was outside hours of duty, and that he cannot recover from the Government damages for the Government's use of his invention.—*Moore v. United States. Supreme Court United States.*

This is a suit by the Union Sulfur Company against the Freeport Texas Company for infringement of patents. An appeal from a district court on part of the claimants. Sulfur is found in rock formation. When this rock is subjected to sufficient heat the sulfur liquefies. This liquid thereafter solidifies into the sulfur of commerce. Prior to the American method sulfur mining was carried on in the ordinary way, viz., stripping where the sulfur was near the surface, or shafting where the sulfur rock was too deep for stripping. Nine-tenths of the world's supply was produced in Sicily which furnished 400,000 tons, Japan 15,000 tons, and the United States a few hundred. How water, the enemy of the miner, was kept from flooding the mines where the old methods were employed does not appear, but was later overcome by pumps as appears in the plaintiff's exhibit. Mr. Frasch, for the plaintiff, announced a revolutionary method of drilling a small sized hole into the sulfur bed, carrying down hot water to melt the sulfur, and then pumping the liquid sulfur to the surface. This plan was looked upon as visionary, and when suggested to men and companies in Italy and England, who were accustomed to shafting and stripping mining, it was considered as impossible. Frasch had patented two processes—one in which hot water was used to liquefy sulfur—the second in which the sulfur was liquefied by chemicals. It is held that it involves no invention to apply the hot water at two different levels, or after he had melted it to use air pressure

(Continued on page 592)

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

OVERALL JACKET OR WAIST.—J. S. ELLIOTT, Eddy, Texas. The object of the invention is to provide an overall jacket which permits of its formation with less material and its use with greater comfort than such articles now in common use. The invention provides an overall terminating at its lower edge in a waist band intended to be seated upon the upper edge of trousers sections, thus avoiding the extension usually tucked into the trousers.

Electric Devices

ELECTRIC RECIPROCATING DEVICE.—G. JOHNSTON, Richmond, Va. The invention is especially applicable to electric guns, riveting devices, pumps, hammers, etc. An object is to provide a reciprocating arm whose movement is effected by electro-magnetic means, said means serving to draw the arm in one direction, while the tension device, such as a spring, tends to carry the arm in the opposite direction at the end of the stroke; the tension may be readily controlled, being increased or diminished at will.

RADIATOR.—W. R. JONES, Box 4, Summitville, Ind. The invention has for its object to provide a device adapted to utilize electric current wherein a series of heating units is provided with a suitable casing, the casing carrying also a tank for water and absorbent wicks arranged adjacent to the heating units and dipping into the water, together with an electrically controlled fan beyond the wicks for driving a current of air over the wicks and over the heating units to thoroughly heat and moisten the same.

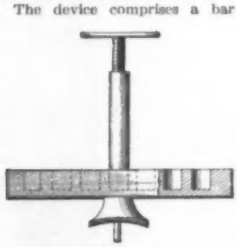
Of Interest to Farmers

SICKLE-GRINDER.—J. C. NOEL, Bellevue, Idaho. This invention has for its object to provide a device wherein a supporting frame is provided having means for clamping the sickle, and wherein the grinding means is carried by a movable support movable toward and from the sickle manually, and normally spring pressed away from the sickle, the support having means for rotating the grinding means.

IRRIGATING APPARATUS.—J. L. PENNINGTON, Box 91, Tonopah, Nev. An object of the invention is to provide a device which may be used in connection with flowing streams, and by means of which the water from the stream may be elevated above the banks thereof and delivered to the surrounding country; the device also serves as a dam thus conserving the water and permitting its use at a time when it is needed.

Of General Interest

EMBALMERS' CHIN REST.—E. A. BRADY, 10th and Water Sts., Oregon City, Ore. The object of the invention is to provide a device which will close and hold closed the mouth of the subject. The device comprises a bar having



A VIEW OF THE PARTS IN SECTION

intermediate its ends a base for engaging the chest of the subject, and a standard connected with the bar and adjustable longitudinally thereof, and sections adjustable longitudinally of each other, one for connection with the bar and the other for engaging the chin of the subject.

VISIBLE AND EXPANSIBLE CARD INDEX.—J. A. BEST, 205 Broad St., New York, N. Y. The main object of the invention is to provide means to enable one to expose to view names or other indicia contained on the index cards of card indexes. A further object is to provide means to accomplish the above without consuming any additional space than that now utilized by the common type of card index system now on the market.

WICK HOLDER.—F. A. MCGUIRE, Iola, Kans. This invention is especially designed for use in sanctuary lamps to support the wick in such manner that it may be easily removed without the necessity for touching the same with the hands, and wherein the remnants of burnt wicks may be expelled by the insertion of the new, the wicks being firmly held, but in a yielding manner, to provide for use of different sized wicks.

HUMIDOR.—L. A. SMITH, Port Gibson, Miss. The object of the invention is to provide a humidor for simultaneously moistening and flavoring cigars, and like articles, wherein holders for flavoring extracts are provided, having a valve normally closed and provided with a receiver for engagement by the end of the cigar to open the valve and means for driving a blast of air through the flask the flavoring extract and the valve into the cigar.

FLOOR DRAIN.—E. GROSVOLD, care of A. H. Shoemaker, Eau Claire Nat. Bank Bldg., Eau Claire, Wis. The invention is more particularly intended for use in connection with a combination floor drain and trap, in which the clean-out pipe is disposed transversely to the drain for communicating therewith. An object is to provide a plug member having a limited guided movement whereby to limit the opening movement of the plug, and to prevent its complete withdrawal, avoiding the misplacing or loss of the plug.

BROOM HOLDER.—H. SHOWALTER, Hurley, Okla. The object of the invention is to provide a device by means of which one may assemble one's own broom, needing only the straws and

PERSPECTIVE VIEW OF HOLDER WITH THE PARTS SEPARATED

the holder. The device comprises a handle, a sectional clamping ring for embracing a shaped bundle of broom corn, and a hood shaped to fit the inner end of the shaped bundle and to fit over the clamping ring to cover the same and prevent disengagement of the pins.

GARBAGE-CAN.—J. A. JONES, 1602 Commerce St., Dallas, Texas. The object of the invention is to provide a device of the character specified adapted for use on side walls and in public parks, wherein foot operable mechanism is provided for opening the lid of the can, which is normally spring held closed, and wherein means is provided for limiting the opening movement of the door.

PLATE LIFTER.—S. G. SINGLETON, Box 811, Burke, Idaho. The invention has for its object to provide a device especially adapted for handling pie plates and the like, wherein a handle is provided having means in connection therewith for gripping the edges of the plate, the said means being releasable at will and spring controlled to grip the plate.

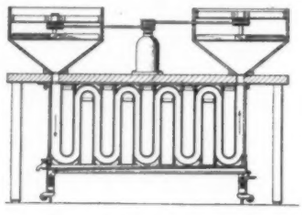
METHOD OF MAKING LACE HAIR-NETS.—R. SAENGER, 239 Fourth Ave., New York, N. Y. The invention relates to the process of making in a rapid, uniform, and efficient manner ladies' lace hair nets, and has particular reference to that type of nets characterized by the use of an elastic cord laced into the rim or edge of the net, and having the inherent quality of puckering that portion so as to hold it automatically around the head.

ADJUSTABLE SHADE-ROLLER HANGER. T. W. FLOWERS, Goldsboro, N. C. The invention has for its object to provide a hanger for shade

PART OF A WINDOW CASING SHOWING INVENTION APPLIED

rollers, that can be adjusted to fit any size of shade-roller or window casing, one of the important features of the hanger consisting in the construction of the roller brackets at the ends of the hanger.

DEVICE FOR CHILLING AND DRYING AIR.—B. J. DU BOSE, Lisbon, Ga. Heat produced in the body must at length escape to preserve the proper blood-heat, either by cool air or by evaporation. It is the object of this invention



A SECTION OF THE DEVICE WITH PARTS BROKEN AWAY

to provide a device for chilling and drying air to fit the air for use in sick rooms, and rooms in which perishable commodities are stored. The device comprises a casing for holding ice, a series of air passages, a fan to take the air into the casing, and another fan to withdraw and deliver the cooled air.

WEIGHT PLACING AND PROVING ATTACHMENT.—G. G. and E. L. VOLAND, 48 Trinity Place, New Rochelle, N. Y. Among the principal objects which the invention has in view are to indicate the placement of balancing weights on the balancing beam of a weighing scales, to show the fraction of the divisional space where a balancing weight member is placed in service, to provide the readings of a fractional unit weighing scales, and to facilitate the handling of the same.

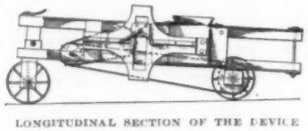
Machines and Mechanical Devices

RADIUS AND CONTOUR CUTTING ATTACHMENT FOR GRINDING MACHINES.—A. ZEIDLER, 161 Clinton Ave., Bridgeport, Conn. The invention has to deal more particularly with an attachment for supporting the diamond or carbon point in such a manner that any desired contour can be cut in the emery or other grinding wheel; the device is so designed that almost an infinite variety of adjustments can be obtained for cutting concave, convex or compound contours.

SAWING MACHINE.—C. J. WEBORG, Pender, Neb. The object of the invention is to provide a light, durable machine, capable of use in felling or cutting up trees, wherein the arrangement is such that the tree may be cut close to the ground, to permit the use of agricultural implements over the ground without the necessity of removing the stump.

WATER BOX FOR CALENDERING MACHINES.—W. H. JACKSON, 47 Lewis St., Lockport, N. Y. The invention relates to the manufacture of paper, its object is to provide a water box more especially designed for giving a "water finish" to the paper while the latter passes through the calendering machine, and arranged to prevent leakage of the water especially in case the calender roll should pick up foreign matter liable to lodge between the surface of the calender roll and the water supplying strip of felt.

BAILING PRESS.—S. J. COATNEY, Fallon, Nev. The invention has for its object to provide a plunger formed from sheet metal, together with means for operating the same, which may be



LONGITUDINAL SECTION OF THE DEVICE

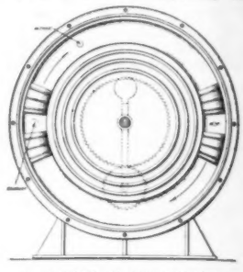
driven from a motor mounted upon the press; the motor may be used to propel the frame, being connected to rear axle by means of a sprocket chain which connects a sprocket wheel on the rear axle with a sprocket wheel on the shaft.

PITMAN.—J. WARRENER, SR., 276 Buffington St., Fall River, Mass. The invention has for its object to provide a device of the character specified especially adapted for use with looms for connecting the reed with its operating mechanism wherein the pitman is made adjustable to permit compensation for wear. In the invention, all elements except the wooden blocks are of metal and when the blocks become worn they can be replaced at slight expense.

POWER-TRANSMISSION DEVICE.—W. L. SNIDER, Dugan Stuart Bldg., Hot Springs, Ark. The invention has for its object to provide a device wherein the driving and driven shafts may be connected together to rotate at any desired relative speed between zero and a direct drive. In practice, the ratio of the gears is such that the power is first transmitted with a three to one reduction, and from that on a gradual lessening ratio until the transmission is direct.

Prime Movers and Their Accessories

ROTARY ENGINE.—R. E. LUIKART, Sioux Falls, So. Dak. The object of the invention is to provide in an engine a pair of piston supports, each carrying a pair of oppositely arranged



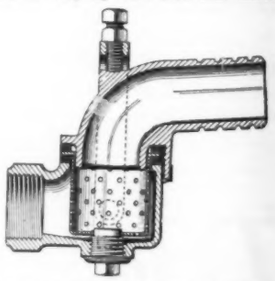
A SECTION OF THE ENGINE

pistons mounted to move through a common annular passage having intake and exhaust ports and igniting means, and wherein the piston supports are so connected that the pistons of the supports will serve alternately as propelling positions and abutments.

GAS AND OIL-SAVING DEVICE.—H. R. SCOTT, Lordburg, N. M. The invention has for its object to provide a device adapted for use in internal combustion engines, or forcing a certain quantity of cold air into the rear of the crank case to prevent heating the oil and motor by heat from the cylinders, and for drawing the air laden with fuel and oil from the front of the crank case through the carburetor.

Railways and Their Accessories

LOCOMOTIVE-TANK HOSE CONNECTION AND STRAINER.—G. E. HEYSER, Manchester, Ga. The object of the invention is to provide a connection especially adapted for use between a locomotive and its tender, for the purpose of coupling tank hose and thoroughly



A LONGITUDINAL VERTICAL SECTION

removing from the water by straining all scale and the like; the connection will permit a large body of water to pass, and is so constructed that even when the strainer is partly choked, there is still room for free passage of water.

Pertaining to Vehicles

BRAKE FOR MOTOR VEHICLES.—J. ABLE, 709 McGarock St., Nashville, Tenn. The invention has for its object to provide a brake operated upon the same principle as the airbrake, wherein a compression cylinder is provided and a storage tank, the storage tank being connected to the cylinders to cause the engine to store pressure in the tank and wherein the brake may be controlled by any suitable means.

Patents and Profits

(Continued from page 572)

keen business man, will not take the initial risk of purchasing Roe's patent if it were liable to be taken away from him. In that event, as the trade is not yet fully established, the third party has not become interested, and Roe is unable to find a purchaser. As he lacks sufficient capital to promote the thing himself, he loses his reward for his invention. Doe's patent, in like manner, is just so much less valuable, and consequently he will not be willing to risk so much money in developing, and the public will lose even that chance to purchase any machines at all. Without sufficient protection assured by good patents, the promoter will not furnish the capital and enthusiasm necessary to float the new inventions and the inventors will not receive their rewards.

Every once in a while we hear of some scientist who makes a valuable discovery or invention, takes out a patent and dedicates it to the public. This is done with the idea that he is bestowing something valuable upon the public, which the people will appreciate and use. I do not know of a single instance of this sort in which the invention came into general use. There was no interested promoter behind the invention to educate the public to an appreciation of the value of the gift, and what people do not value they do not take the trouble to use. Unless there is a reward to be derived from the effort, no one will take the trouble and drudgery which such development involves, and an invention, no matter how meritorious, will not be brought to the attention of the public and the prejudices of ages overcome to establish its use.

The Cottrell smoke-precipitation patents an apparent exception to these remarks, are indeed apparent only. Dr. Cottrell did not "deed to the public" his invention, in the sense of throwing its manufacture and use open to all. He followed the much more rational course of putting his patents in the hands of a strong holding agency, created for the purpose of holding and exploiting the patents. The public benefit came simply through the proviso that this holding corporation must put back all its profits into scientific research. Put an enthusiastic scientist in charge of such a foundation, and of course he will push the invention for all it is worth, so that he will have all the more funds to go on with other investigations.

So, after the inventor has produced his invention, he must have protection in the form of good patents which will insure a sufficient reward to induce capital and enterprise to place it in the hands of an indifferent and prejudiced public. The better the protection afforded by the patent, the surer the inventor is of an adequate reward, and every limitation upon the terms of the monopoly detracts just that much from his chances of receiving such a reward.

Oddities of the Trans-Atlantic Flight

(Continued from page 575)

Delgada, into which the big machine "taxied" without aid. No destroyers were sighted on the 205-mile surface journey until the NC-3 was just off the port, despite the firing of distress signals by the airmen. The wireless broke down and was therefore useless when the boat hit the water.

As for the fortunate member of the expedition, the NC-4, the flight was without startling incident. From Horta, the NC-4 made the 150-mile flight to Ponta Delgada, whence the next jump of 800 miles will take this remaining boat to Lisbon, Portugal, or the virtual end of the trans-Atlantic flight, probably by the time this is read. From Lisbon the NC-4 will probably go to Plymouth, England, some 775 miles farther. The NC-4, obviously, is the only machine left of the three that started on the great flight.

The lesson to be drawn from the NC attempt is that no preparations can be too thorough to assure the performance of

such a great flight. The machines, staunch and powerful as they were, proved delicate in the face of the unusual storms off the Azores. The directional wireless, while of some aid, did not prevent the NC-3 from getting far off the course. The Liberty engines stood the test in good shape on all three planes. All in all, the failure of two NC machines was a matter of navigational difficulties due to fog and storms of extreme severity.

It seems strange that there should be only two seaplanes entered in *The Daily Mail* trans-Atlantic contest, while all other entries are land-type planes. But when the experience of the NC boats is taken into consideration, one arrives at the conclusion that once a machine has to come down on the surface of a running sea, there is little hope of again rising. Hence why bother with a seaplane, with all its additional weight and head resistance? The average airplane, with its tanks emptied in the emergency, will keep afloat for some length of time. So that explains the preponderance of land-type planes in what would seem to be a hydro-airplane contest.

A Shooting University

(*Continued from page 576*)

it fun to lie on their tummies and shoot now and then at a far-off and tiny square of white, with a still tinier black spot in its center. Mayhap the rifle lover may be enticed over to see why the trap lover thinks it a good time to break a lot of baked mud pies all over the place with a shotgun.

So the great trap shooting organization, the American Trapshooters Association is installing a battery of its traps, and is framing up some big shoots right in the middle of the grounds where the civilian and the "flat-foot," which is Armyese for the sailor, and the militia and regular army teams hold forth with their service rifles. For the first time in history, the same grounds are to see a big clay bird and rifle shoot progressing together.

A complete range is being built where the matches with the small bore rifle, otherwise the humble .22 of the shooting gallery and the small boy, are to be conducted. In the right little, tight little isle of England, where 35,000,000 people make ranges for the military rifle necessarily hard to obtain, hundreds of thousands of the Britisher lovers of the sport, do all their shooting with the little rifle at ranges up to 100 yards. Annually a program of matches for these small bore chaps—not schoolboys nor kids, but full grown and sober-minded men—is pulled off at Bisley in conjunction with the full range matches for the military rifle, and a good lot of prizes are hung up during the two weeks' shoot.

The idea has been transplanted, and the small bore range on the Caldwell grounds is to encourage the movement among the rifle shooters and possible rifle shooters of the country, where even now ranges safe for the military rifle, are becoming difficult to find. The chap skilled with the small rifle, needs but a day or two with the big military arm to become a skilled war shot. The schoolboy will be encouraged to come to Caldwell, nor need anxious mothers have visions of his shooting up or being shot up by others. The tutelage of the skilled blue-jacket instructors, who made expert shots out of thousands of their kind, is to be available to every comer to the Caldwell Navy rifle range.

A hostess house, and a cordial welcome is the contribution for the ladies who feel curious as to whether or not there is anything attractive to the game of burning powder. Every match is to be open to women, and special matches will be framed for them, always with handsome blue jackets to explain why it is a useful health hint not to look down the barrel to see if there is a bullet in it.

The Navy promises the use of a rifle, big or little, free ammunition, and board at the range at the rate of 60 cents per day to the person who wants to attend the shooting university. The general public is cordially invited to come and look on at all times and provisions are made for spectators. There is of course no charge whatever for admission to the range, and none for the use of the range by the shootively inclined person.

While there will be plenty of sport and sportsmen at the Caldwell range, the primary purpose is not a sporting event, it is educational, possibly even partaking of propaganda. To get the present ignorant or indifferent American interested in shooting and thus make of him one more unit in the fighting strength of the country, is the basic idea of the National Matches as run by the Navy.

The three-miles-square Caldwell range is on the Passaic River, land reclaimed by the energetic Navy men, and it is reached via Hudson Tubes to Newark, thence trolley to Caldwell, and bus to the range.

The range is so wide open to the public that there's not a latch from which to hang the traditional string. During the summer there will be demonstrations by tanks, machine guns, trench mortars and other material, to be announced more definitely through the newspapers.

The French Problem of Reconstruction—IV

(*Continued from page 577*)

which has been stopped by the war, as in England; it is a case of a new building, new machinery, a new work force, often new customers. There is nothing with which to start in most cases save a name and plenty of courage. As an instance of what is meant, there is, in the very shadow of Rheims' ruined cathedral, a little print shop. It employed, perhaps, before the war, 40 or 50 people. The proprietor could step to the door and see the facade of the cathedral and if he were religiously inclined be inside its portals in 30 seconds' walk. Today there is no roof to the building, and if a second story existed there is nothing in the walls to indicate the fact. Whatever was higher than the door has fallen on on the presses. Three ruined linotype machines are buried to their keyboards in brick and stone. Every wheel is a mass of rust. Any one can have the lot who wants it; an ironmonger wouldn't give a franc for the entire outfit. And this is one of thousands of cases. That printer must get himself a building, presses, linotypes, cases, types, paper, business, workmen, before he can begin to take his place in the industrial establishment again.

This central reconstitution group is only advisory in character and can do no trading according to French law. So it has formed a body which can trade, which goes by the imposing name of the Comptoir Central d' Achates Industriels pour les Regions Envahies. This body has a small fund of a couple of hundred thousand dollars to its credit but can get all it needs up to the resources of the parent advisory body, as fast as that body wills. It functions by buying machinery and stocks and lending them to manufacturers, who may pay for them in cash, at the saving obtained by the large powers and functions of the trading body, or who can have them charged against the eventual indemnity to be received. So far some 12 millions of dollars of purchases have thus been effected and orders for 40 millions more are in a state of preparation, principally for the reconstitution of coal mines, power plants for electric power, machine tools, etc. Textile industries, breweries and sugar mills are now being helped. Another scheme which is working out slowly is the formation of coöperative societies in individual industries. In the steel industry for instance, since all cannot start up at once, the first one or two which can, operate on credit or capital furnished by all, and divide the profits pro rata. Finally the Association keeps all possible track of all skilled labor both in the army and out of it, so that there will be little time lost hunting for the right men when there is the work for them to do.

How long it will all take only the future can say. There are so many problems all to be tackled at once, and France is not a country nor are the French a people apt to find at once the most efficient and the quickest way. France, perhaps more than England, clings to the old idea. The French are thrifty to the point of absurdity; to the average French mind to throw away is to waste, even if what is thrown away is in itself wasteful to use. Much time is going to be wasted on fruitless attempts to repair and remake what is far better scrapped.

But it is not for the onlooker to criticize. Indeed, after having wandered through these death-like regions and seen the absolute negation of civilization, the complete destruction, and the magnitude of the problem, one is not tempted to criticize. One feels indeed that results would come quicker were there perhaps less fear of the loss of trade which would come by admitting foreign products at once. What France needs is material, tools, and transportation; to keep any of it away with regulation tariff, or import duty is, apparently a mistake. But the French know their own business best, doubtless, and whatever else he has or has not, your apparently ruined French peasant, storekeeper, manufacturer, miner or producer has courage.

In the little town of Belleau, at the foot of the slope which rises to Belleau Wood, just west of Chateau Thierry has come back one lonely inhabitant. Belleau had but a dozen houses and they are now but walls. But the lonely inhabitant is not daunted. With hammer and saw he is industriously patching a piece of a roof for a piece of a house, and he whistles while he works. And that is, after all, the spirit of France today and the answer to all critics who find her reconstruction program somewhat small for the task, and her progress very slow. Whatever her methods, nor how they may be criticised from an American standpoint, she has the stout heart, and in time, and with American machinery, some foreign credit and the lightheartedness which comes from a beaten Hun and Alsace and Lorraine "home" once more, she is sure to conquer in the end and heal her wound, mend her scars and be once more what she has for so many centuries taken such pride in being, La Belle France.

And having seen the hack-saw mark of the Hun across this land and the smile on the face of his victims, having listened both to Paris trying once again to sing and the lonely victim in Belleau town whistling at his hopeless task of remaking a home, one American observer at least is quite, quite willing to lift his hat and cry with all his heart, *"Vive la France!"*

Some Startling Electrical Phenomena with New Form of Vacuum Tube

(Continued from page 579)

nickel, there is an increase in resistance only when the nickel is made positive, but not when it is negative.

It is known that glass at or near its melting point becomes a good conductor. This property of becoming strongly conductive when heated to a semi-fluid state is probably shared by all other so-called dielectrics, but it is obvious that it would be absolutely impossible to operate a vacuum tube at such a temperature. The glass walls of the tube would collapse at about 425 degrees C. The glass will not, however, attain red heat until heated to about 600 degrees C. Electrolytic conduction of glass is observed at far lower temperatures than these. In actual operation the temperature of this electron tube never exceeds 140 degrees C.

The third effect both assists and retards the operation of the detector. It has been found that while conduction is taking place in the glass the products of decomposition are deposited on the electrodes. The second effect is really part of this third effect, it being probably a deposit or an emission of some of the products of de-

composition at the anode which causes its surface to become non-conductive. In the operation of one of these tubes as a detector, some of the products of decomposition are emitted from the inner walls of the tube and are deposited on the cooler portions of the tube. This action is of a beneficial nature, as it would probably aid in cleaning up some of the gases which might be emitted during the operation.

After exhaustive research work Mr. Donle developed the tube to its present forms, which are shown in the accompanying illustrations. Here we have in each case a filament surrounded by a controlling electrode within an evacuated tube, the exterior walls of the tube being coated with a metallic deposit. The static characteristic curve of these two forms shows that there is practically no variation for various tubes. The tube, in effect, is a vacuum, surrounded by an electrolyte, and it is probable that most of its peculiar characteristics are due in a large measure to electrolytic action in the glass walls.

The results obtained with these tubes as plain detectors and as oscillating detectors have been quite remarkable, according to persons who have used them. As a simple detector the response is reported to be greater than that which is obtained with any of the usual types of vacuum tubes; but as a detector oscillating on spark signals, its performance is extremely gratifying, the strength of signals being many times greater than that given by most tubes in general use.

The construction of Mr. Donle's tube is simplicity itself. As will be noted from one of the accompanying illustrations, it consists of a stem, which is shown at *A*, and which contains a diminutive hairpin filament, while at *B* the "control," consisting of a small spiral, is placed over and about the filament and connected with the middle lead-in wire of the glass stem. The glass stem is then placed in a glass container as shown at *C*, after which the air is removed by means of a vacuum pump. The mass of the inner structure is so extremely small that it is a very simple matter to drive the gas from it. The usual procedure is to light the filament and then bombard the control by the application of a sufficient potential between it and the filament, the entire operation requiring less than one minute. The nickel supports are freed from gas before assembly. The outer surface of the glass container receives a narrow band of silver paint which is then melted into the glass, so as to form the "plate."

Mr. Donle states that the alinement of the filament and "control" is not at all critical, it being only necessary to see to it that the filament is placed as near the center of the "control" as possible. The position apparently makes no difference in the operation as long as the control does not touch the filament. The structural advantages of the new tube are quite obvious, when compared with standard tubes. Instead of having an area of metal inside the tube of several square centimeters there is hardly as many square millimeters. In order that the tube be held at a fairly constant temperature during operation, an outer shell of glass is slipped over the tubes proper when it is cemented into its socket. This shell is provided with two small holes near its base which prevent the temperature from becoming excessive. With this shell removed the operation is quite satisfactory, if there is no draught. The shell protects the tube from draughts and mechanical injury.

The uniform operation of the Donle tubes is most remarkable. It was at first expected that commercial variations in the glass thickness, and so on, would materially affect the operation. Such, however, is not the case, and made under ordinary conditions they run entirely uniform; so much so, in fact, that tubes may be interchanged in any circuit without the necessity of readjustment. In short, the tube described possesses not only certain superior electrical characteristics, but is readily and cheaply produced in any quantity.

A Successful Type of Anti-Noise Transmitter and Loud-Speaking Telephone

(*Continued from page 579*)

relation to the diaphragm, in order to prevent it from being held horizontally at any time. Other transmitters, when used by airmen, are apt to be held horizontally when looking over the side of the airplane, with the result that the carbon granules fall away from the front member of the button and the transmitter becomes inoperative. With the button at an angle, however, it is impossible to bring it into the horizontal position unintentionally. The transmitter is held in a perforated casing which permits all sounds to reach the front and back of the diaphragm, while a push button permits the transmitter to be cut into circuit when desired.

Aside from the anti-noise transmitter, which, it is interesting to note, is employed on the Navy NC planes and other multiple-engined machines, the same inventors have developed a loud-speaking telephone of novel design. Instead of the usual heavy diaphragm attracted by a pair of electromagnets, they have made use of a pair of powerful electromagnets with right-angle pole-pieces between which vibrates a coil. The coil is fastened to the diaphragm by means of a wire, and moves up and down across the lines of the magnetic flux. The electromagnets are connected in circuit with a powerful storage battery, while the telephone current is passed through the fine winding of the coil.

Highly interesting results have been obtained with this saturated-field electrodynamic type of loud-speaking receiver. Indeed, sounds have been transmitted over distances of several miles, and during one of the tests the sound waves were heard some seven miles away. President Wilson's Victory Loan message was read by Lieut. H. E. Metcalf, a radio officer, while flying over Washington, D. C., at an altitude of 2,600 feet, and was distinctly heard by 15,000 persons assembled on and about the south steps of the Treasury. Every sound but the voice speaking through the transmitter was eliminated. Instead of over a hundred loud-speaking units as were used on Victory Way, New York city, this loud-speaking telephone emitted all the sound waves from one source, thus making for more realistic and more understandable speech.

The anti-noise transmitter of Messrs. Pridham and Jensen has been used on all the airplanes of the United States Navy, and on many of the airplanes of the French and British armies. The instrument is now being installed on the vessels of the United States Shipping Board. And with the apparatus released for commercial purposes, there should be some interesting developments in telephony and public speaking. The new desk telephone employing the anti-noise transmitter has a receiver for each ear and looks like a physician's stethoscope greatly enlarged, while the transmitter has the appearance of a young collender fitting closely to the mouth. The inventors assert that the only proper way to use a telephone is to listen through both ears. With this desk telephone set, the circuit is automatically made by removing the hand set from the double hook, and broken by restoring the instrument to place.

The Heavens in June, 1919

(*Continued from page 580*)

of the equator, and remains visible until after 11 P. M. by the clock all through the month.

Mars is a morning star in Taurus, but will be very hard to see, even at the end of the month, as he rises only an hour earlier than the sun.

Jupiter is an evening star in Gemini, and now sets before Venus, at about 11 P. M. on the 1st and 9.30 on the 30th.

Saturn again is an evening star, in Leo, and sets a little after midnight in the middle of the month.

Uranus is in Aquarius. He crosses the meridian at 5.30 A. M. on the 18th, and is

therefore, observable before the dawn begins.

Neptune is in Cancer, and an evening star. He is in conjunction with Venus on the 14th.

The moon is in her first quarter at 8 A. M. on the 5th, full at noon on the 13th, in her last quarter at 2 A. M. on the 21st, and new at 5 P. M. on the 27th. She is nearest the earth on the 25th, and farthest away on the 10th. As she traverses her track round the zodiac, she comes into conjunction with Jupiter and Venus on the 1st, Neptune on the 2d, Saturn on the 3d, Uranus on the 19th, Mars on the 26th, Jupiter and Mercury on the 29th, and Neptune on the 30th.

Princeton University Observatory.
May 17th, 1919.

A Stethoscope for the Earth

(Continued from page 581)

Mining engineers believe the geophone will be useful in preventing accidents from explosions, when breaking through. This yet remains to be tested, buf it is certain that within several hundred feet, it is perfectly possible to distinguish the difference between tamping a charge, using a pick, hitting with a mallet or a sledge or almost any other sound. It is difficult to describe this ability of the little earth stethoscope to make sounds recognizable, but it is remarked by all who use the instrument for the first time.

Observations were made recently of a mine fire burning from twenty to forty feet below the surface. A low rumbling noise could be heard as if air were being drawn in long crevices, and occasionally sounds could be heard from the snapping and falling of pieces of coal or rock. As well as can be determined, the fire area was accurately located, but owing to the fact that the fire could not be approached from the inside the data was not checked absolutely. It is interesting to note that similar sounds were heard from only one point on the inside of the mine and that that point was the one nearest the area as located on the surface.

It has been found also by the Bureau of Mines engineers that the instruments can be employed quite advantageously in locating knocks in automobile valves and cylinders. For this purpose it is well to mount the instrument on a short iron rod that can be easily inserted in and around the machinery. In this manner not only can a troublesome cylinder be located, but the trouble area in the cylinder can also be found.

After the investigative work has been completed a course of instruction in the use of the geophones will be developed and recommendations will be made as to what procedure it will be best for a rescuer to follow when using the instruments as well as what had best be done by an entombed miner.

The Current Supplement

THE principle or hypothesis of relativity, which has been under discussion for 25 years or more, is now being developed into a theory of broad bearings. These recent developments make it all the more important that we stop here to review both old and new hypotheses in this field, and our readers will be glad to have before them the clear discussion on *Physical Relativity* which the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2265 for May 31st, 1919, offers. Another interesting survey and review is presented by the article discussing *The Influence of Astronomy on Human Thought*, wherein it is brought out how important astronomical research has been in shaping our ideas of space and of time, during the history of human thought. Our iron-makers and acid manufacturers will be more interested in the article, *Acid-resisting Iron*, which reviews human efforts to produce a resistant iron which shall take the place of the expensive rarer metals possessing this property. The steady increase in demand for economical fuels will attract attention to the work of the

Submarine Defense Association in devising efficient *Colloidal Fuels* and their communication on the subject in this issue deserves the careful attention of all fuel users. The well illustrated articles on shell-making animals are continued with the second installment of *The Shell Builders;* and another interesting collection of photographs illustrates *Some Native Industries of German Cameroon* A long summary of several papers presents the *Influence of Aviation on Mathematical Physics;* and a long unillustrated discussion on *Cutting Lubricants* presents the results of a British survey of this field designed to bring out known but little realized facts regarding their use. Photographers will welcome the suggestions and experience embodied in the two papers, *Covering Power and Illuminating Power of Lenses* and *Position of the Illuminant in Enlarging and Projection.* Shorter articles or abstracts include *Concrete as a Chemical Engineering Material; Artificial Gravel* made from clay for a concrete ship; *Determination of the Compressibility of Solids at High Pressures; The Sizes of Cells; Philosophy and Spiritualism.*

Recent Patent Decisions

(*Continued from page 584*)

as a means of bring the liquefied sulfur to the surface. All of these patents in contention were granted to Frasch, after patents covering substantially the same ideas had been granted to Frasch, and the later patents do not show sufficient invention, in view of the earlier patents, to make them valid.—*Union Sulfur Co. v. Freeport Texas Co. U. S. C. C. A. of Del.*

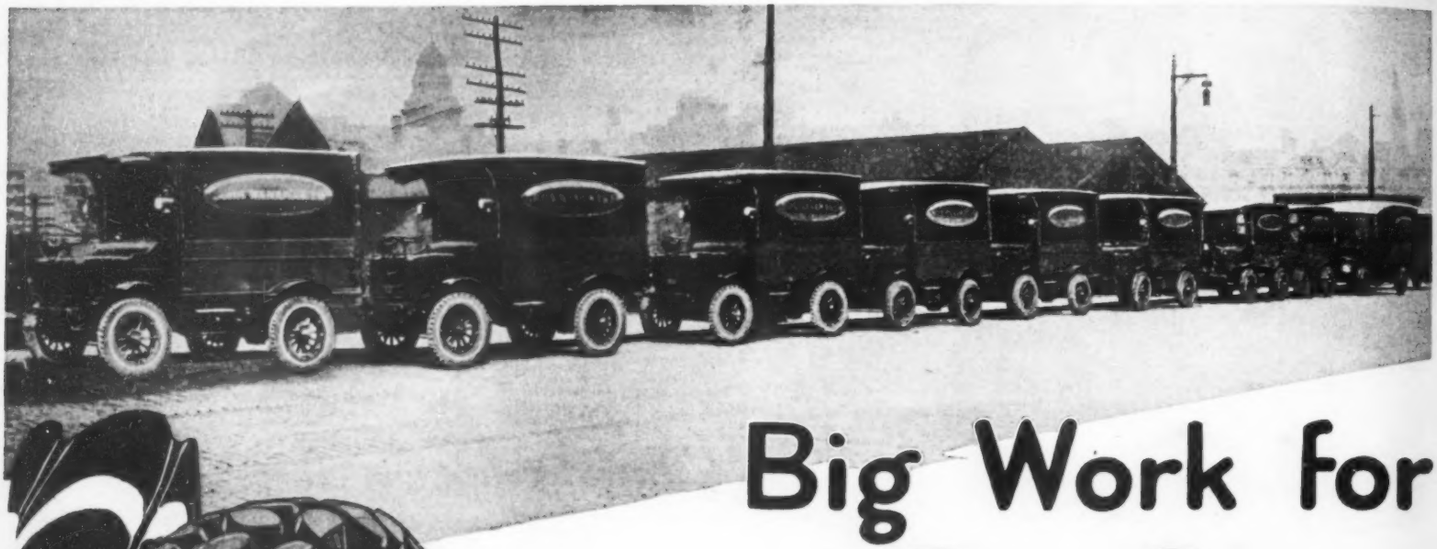
The invention herein relates to mechanical musical instruments such as the pianola and the piano-player, wherein musical notes are automatically sounded by pneumatic mechanism actuated by a travelling sheet of perforated paper. The state of the art records the advance of a mechanical musical instrument. It contained, first, means for the mechanical sounding of musical notes, governed in their production and duration by the other mechanical means of a travelling sheet of perforated paper—and second, means for giving artistic effects to the sounds thus mechanically produced by controlling their speed and volume. The latter means embraced a number of parts termed controllers, so that the production was musical according to the skill with which the performer moved the controllers. When Mr. Young, the patentee, entered the art some musical knowledge and skill were required by the performer to render artistically a musical composition. In the Young patent nothing is left to the skill or interpretation of the performer in supplying musical effects when a certain line changes its position and direction. The performer does not have to read it. The purpose of the invention is to facilitate the shading of music so that a person who has no musical knowledge can reproduce a musical composition of high order, not with tolerable fidelity, but exactly as the skilled pianist had played it. What Young did was to extend the tempo controller mechanism over the travelling sheet and fasten a pencil to it. When he played the piano, the sheet moved against the pencil, which drew a line lengthwise the sheet and throughout the musical composition. This line varied in direction with each variation of musical effect given by the performer. The changes of direction were not sudden, abrupt or angular, but were bending and sinuous, and in the sinuosities of the line were exactly recorded every variation of tempo expression. What Young achieved was to impress upon a musical composition, and upon every note of it, his interpretation of its musical effects and to embody them in the line thus drawn. What Young gave the art was an idea whereby the interpretation of a master performer can be exactly reproduced by an unskilled performer merely by following the line impressed upon the sheet, not by his eye or by his mind, but by a pointer attached to the controller mechanism and extending over the music sheet. The defendant says that invention was not involved in this. Because it involves uncovering a thing, which, while long capable of being done, was never before thought of, it is held that invention is involved.—*Cunningham Piano Co. v. Aeolian Co. U. S. C. C. A. of Penna.*

The mechanism at issue embraces an automatic device for cutting a flowing stream of molten glass, means for discharging the same, and means for shifting the molds to receive the severed glass, and also for cutting knives acting upon the flowing stream. It appears that the difficulty in the manufacture of glasswares and the efficient handling of molten glass has been a problem difficult to solve. The molten glass is viscous. Mr. Brook, the patentee, claims to have solved the problem by treating or handling successfully the flowing stream of molten glass. The defendant claims also to have solved the problem. Its machine in no way handles a continuously flowing stream. It claims that its machine approaches the hand punty method, in that a separate gather is obtained, somewhat similar to the gob or gather obtained under the old hand punty method, and thus a better result is obtained in the finished product. In the Brook device the molten glass is allowed to escape through a hole in the bottom of the furnace and it flows continuously as soon as the plug is withdrawn to allow the molten glass to escape into the molds. In defendant's machine there is no hole in the bottom of the furnace. The molten glass is held within the furnace and cannot escape until propelled over the lip of the dam by means of a paddle because the crest of the spout is above the normal level of the molten glass in the tank. It is held that the Brook patent is not infringed by the patent of the defendant, having a distinctly different principle of operation —*Brook Glass Co. v. Hartford Fairmount Co. U. S. D. C. of Conn.*

The evidence in this case shows that Messrs. Milton & Kane were plaintiff's employees. Milton was Kane's superior being employed as an inventor whose inventions were to belong to plaintiff. For a year he was working on a high tension magneto for variable speed, multi-cylinder gas engine, which gave great promise, and was the means of securing a large contract with the Cadillac Company, but which was a failure. Later, there was danger of plaintiff losing its business with the chief user of the invention, the International Harvester Co. Mr. Webster, the President of the plaintiff, urged Kane and an employee by the name of Shiville to invent something to solve the difficulty. Kane made a drawing of a new device and a machine was made accordingly which worked satisfactorily. Milton claims that the idea was his. The drawings bear the name of Kane and other evidence support Kane's invention. It is, therefore, held that the Kane patent is valid and infringed. —*Webster Electric Co. v. Bodelsak et al. U. S. D. C. of Ill.*

Aerial Conductors of Aluminum

IN view of the extended use of aluminum wires and ropes for overhead electric lines the German Association of Electricity Works last October issued Advisory notes as to the installation of such lines. It is very essential to keep the surface of aluminum intact; hence wires and ropes should not be dragged over stony ground or over sharp edges. Care should also be taken not to put on too high tension in stretching the wires. Contact between aluminum and iron is to be avoided; where that is impossible, pieces of aluminum foil should be interposed between the wire and the iron; iron wire should not be used in making attachments, but should be replaced by aluminum wire. Contact between the aluminum and copper is still more to be guarded against, and where the two metals must be brought into contact, the moisture should at any rate be excluded, by varnishing the parts, or other means.



Big Work for a Big Store

The delivery system of a great city store is an extremely high-powered and high-tensioned service, which directly affects the convenience and satisfaction of thousands of customers. Its effectiveness is gauged by its swiftness and smoothness; its success is measured by its safety and certainty. Naturally, the need of perfected equipment is imperative.

JOHN WANAMAKER, Philadelphia, operates a large number of two-ton trucks in his delivery system. These trucks are required to travel long distances at high speed and cover a large area each day.

This fleet of cars covers an average of 4,000 miles daily. It carries a total daily average of 45 tons of goods. It is kept constantly keyed up to a big job—and does it well!

It is a significant fact that 50 of these Wanamaker cars are equipped with 'Nobby Cord' Truck Tires—the big, burly tires that are built for long mileage and hard usage. The tires that welcome any test.

'Nobby Cords' cut costs of operation. They minimize repairs and replacements. They are known to reduce truck depreciation 50 per cent. and to save 30 per cent. in gas and oil consumption.

'Nobby Cords' are remarkable for their incredible strength and sturdiness. A carcass that is almost unassailable and a cover that is almost impregnable. A veritable fortress in power of resistance.

Many big users have found complete tire satisfaction in 'Nobby Cords'. Always ready to tackle any task—no road too long—no load too big—no job too strenuous.

For passenger and light delivery cars—'Royal Cord', 'Nobby', 'Chain', 'Usco' and 'Plain'. Also tires for cycles, airplanes and solid tires for trucks.

United States Tires are Good Tires